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ECONOMICS INFORMATION
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SURVEY OF PESTICIDE USE IN ONTARIO, 1988
Estimates of Pesticides Used on Field Crops, Fruits and Vegetables.

by

Jacqueline Moxley

Economics and Policy Coordination Branch
Ontario Ministry of Agriculture and Food
Legislative Buildings, Queen's Park
Toronto, Ontario
M7A 1B6
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INTRODUCTION

Organic pesticides have been used in Ontario since the end of the second World War. The concern expressed by many groups regarding the contamination of fish and wildlife resulted in the need to identify and quantify the pesticides used in the Great Lakes Watershed.

Canada and the United States signed the Great Lakes Water Quality Agreement in 1972. The International Joint Commission (IJC), acting for the two governments, oversees all activities in pursuance of this Agreement. As part of the Water Quality Agreement, the IJC established the Pollution from Land Use Activities Reference Group (PLUARG) to determine sources, quantify inputs, and assess the impact of inputs from a variety of land use activities on water quality. These activities include those involved with agriculture as well as forestry, city and urban areas, highways, and other industries. Documentation of the volume of each pesticide used in Ontario at both the county and watershed levels was essential to these studies.

The PLUARG group requested in 1972 that a survey of pesticide use be carried out every five years in the Province to identify and quantify the pesticides used in the Great Lakes Watershed. The data collected would be useful in estimating pesticide use in pursuance of the IJC Agreement; detecting trends in pesticide use by crop and by region in Ontario; and gauging the local and overall effectiveness of this Ministry's extension work in pest and weed control.

Since 1973, surveys of **agricultural** pesticide use have been carried out every five years by the Ontario Ministry of Agriculture and Food (OMAF) in consultation with personnel from the Ontario Ministry of the Environment, Agriculture Canada, the University of Guelph, and the Canadian Agricultural Chemical Association. The technical aspects of these surveys have been handled primarily by the Statistics Section of OMAF's Economics and Policy Coordination Branch. The results appeared in Survey of Pesticide Use in Ontario, 1973 [9], 1978 [10] and 1983 [8]. These reports dealt with three aspects of pesticide use: field crops, fruit and vegetable crops, and roadside spraying.

The 1988 survey of pesticide use included field crops, fruits and vegetables. Roadside data were not collected in this survey year. The field crops component consisted of a questionnaire mailout to a sample of 10,000 farmers. The survey of pesticide use on fruits and vegetables was sent to 3,200 producers. This report presents the findings of these studies.

SURVEY OF PESTICIDE USE ON FIELD CROPS

SAMPLE SELECTION AND MAILOUT

The Agriculture Division of Statistics Canada maintains, on an ongoing basis, a list of all agricultural holdings in Canada. This list, known as the Farm Register, contains all current census farms. The most recent Census of Agriculture, conducted on June 3, 1986, defined a census farm as an agricultural holding receiving $250 or more from the sale of agricultural products during the previous year.

After discussions with the Economics and Policy Coordination Branch, OMAF, the Agriculture Division agreed to generate from the Farm Register the sample (names and addresses) required for the Pesticide Use Survey subject to the following constraints:

1. A total sample size of 10,000 farms was to be selected for the study. This choice was consistent with the resources available and the sample size required to yield sufficient confidence in the results, assuming a response rate of approximately 30 percent.

2. The sample was to be drawn from a sub-population taken from the 1986 Census of Agriculture for Ontario. This sub-population consisted of all census farms having a total of 7 hectares or more grown to wheat, oats, barley, mixed grain, rye, corn, soybeans, dry field beans, canola or tobacco. (Confidentiality requirements dictated that Statistics Canada augment this sample with a small number of farms having a total of less than 7 hectares of the aforementioned crops.)

3. The sample of 10,000 farms was to be chosen from the sub-population according to a county level stratification. Simple random sampling was to be carried out within each county.

The sample sizes allocated to each county were determined as a compromise between two main considerations:

1. The distribution of total pesticide use in the 1983 version of the survey; and

2. The distributions of the principal field crops in the Province.

The individual allocations for these two criteria differed only moderately from each other.

Subsequent to selecting the sample, the Agriculture Division generated a number of tabulations and frequency distributions for both the sub-population and the sample farms. Analysis of these data confirmed that the sample was sufficiently representative of the target population.

The selected farmers received Pesticide Use Record Forms in April of 1988. They were requested to complete these forms during the crop growing season by noting the dates of application, crops sprayed, chemical product used, concentration used, area sprayed, and total amount of product used. A summary questionnaire mailed to the same panel in September 1988 asked them to record the crop, chemical product used, concentration, area grown, area sprayed, and total quantity of product used. This latter form was to be returned to the Economics and Policy Coordination Branch, while the producer was encouraged to keep the record sheet for his own files.

Of the 10,000 forms sent out, about 2,600 were returned. A telephone follow-up of the responding versus non-responding producers in the 1983 survey determined that the non-responding producers were representative of responding producers so this procedure was not repeated in 1988.

EDITING

The questionnaires were edited to bring about a certain standard of conformity that would allow the data to be analyzed. Each questionnaire was checked manually by personnel from the Provincial Pesticide Residue Laboratory and the Economics and Policy Coordination Branch and by computer for internal consistency and completeness.

Care was taken to ensure that the ratio of product used to area sprayed made sense as an application rate. In cases where the amount of product used or the area treated were not filled in, it was often possible to impute the missing data by using recommended standard concentrations. Quantities of active ingredients for each chemical were calculated by multiplying total product used times the proportion of active ingredient contained in that product.

Occasionally, pesticides are applied as a combination of two or more chemicals. An example of this is the herbicide blazine, which is actually a combination of cyanazine and atrazine. Whenever such combinations were given as responses to the survey, the contribution of each component was estimated separately using standard mixing ratios. For purposes of this study, such estimates were added to the usage of the individual chemical. For example, the cyanazine component of blazine applications was credited to total cyanazine use. The atrazine component was treated in an analogous fashion while no separate estimate was made for blazine.

EXPANDING THE SAMPLE DATA

The main purpose of the survey was to calculate the use of pesticides in the Ontario river basins that drain into the Great Lakes. The estimation technique consisted of expansion to: (1) the county level and (2) the drainage basin level.

County Level

Each questionnaire contained a numerical geographic code. Using this unique identification number, the Agriculture Division of Statistics Canada was able to perform a computer match of those producers who completed the Pesticide Use Survey with their responses to the 1986 Census of Agriculture. Specifically, this meant that summary tables for each of the major field crops could be produced at the county level collectively for the 2,600 producers who responded to the Pesticide Use Survey.

The importance of this point is three-fold:

1. These tabulations provide a final check for representativeness of the responding portion of the sample.

2. Whereas farmers often listed only those crops which they had treated with pesticides, the 1986 Census data covering all field crops were used to complete the pesticide questionnaire. Otherwise, estimates of pesticide use would have been inflated.

3. The expansion factor for each crop in each county is unique provided sufficient sample coverage existed for the county; otherwise, regional expansion factors were used where necessary. These factors are calculated as the ratio of the total area of a particular crop in the county [region] to the area of that crop reported in the questionnaires returned from that county [region]. See Appendix I for a detailed example of this calculation.

In some counties, the estimated use of specific pesticides is zero when, in fact, it is likely that these chemicals had been applied. There are two main reasons for this result:

1. The use of such pesticides was not detected in the sample; or

2. The area grown to a particular field crop, while existent, was too small to be estimable in a county - hence, no expansion factor could be computed.

In addition, some chemicals which are no longer licensed may still be reported as stocks in storage diminish.

River Basin Level

Watersheds do not follow county boundaries. Some basins drain only part of one or two counties, while others may cover parts of five or six counties and drain one county completely.

River basin boundaries for the 1988 survey correspond to those used in 1983. Estimates have been made in this study for each of the 12 groups of river basins. In addition, the "lakeside land" categories of Huron, St. Clair, Erie, and Ontario have been maintained in order to account for land not considered to fall into a river basin, but still lying in close proximity to each of the lakes.

For a map of the areas covered by each river basin grouping, please refer to Figure 1.

The drainage basin boundaries were originally outlined on township level maps. In 1983 and 1988, these were designed to conform as closely as possible with the river basins used in the 1978 study with the added constraint that townships would not be subdivided. (The 1978 survey differed in that proportions of each township located in each river basin had been derived and used in the estimation procedure.)

Since the numerical geographic code contained on each questionnaire indicated township as well as county location, it was a straightforward matter to assign respondents to the appropriate river basin. Then, depending upon crop and county, the expansion factors described previously could be applied to the pesticide use of each sample individual in a particular river basin. Summation through all such results gives rise to the estimated pesticide use for the drainage basin in question.

Mathematically, this gives the same results as summing the sample pesticide use by crop for each county contained (whole or in part) in the river basin and then applying the appropriate expansion factors.

SURVEY OF PESTICIDE SURVEY USE ON FRUIT AND VEGETABLE CROPS

SAMPLE SELECTION AND MAILOUT

The responsibility for conducting the fruit and vegetable segment of the Pesticide Use Survey was assigned to the Plant Industry Branch, OMAF, in cooperation with the Economics and Policy Coordination Branch.

A sample of 3,200 fruit and vegetable growers was selected using the 1986 Census of Agriculture as a basis. As was the case with field crops, consideration was given to specific crop areas and past pesticide applications in designing the sample.

Forms were mailed to producers in the spring. During the crop growing season, each grower was asked to record the date of pesticide applications, crops sprayed, area sprayed, chemical product used, concentration used, and total amount of product. In September 1988, another questionnaire was mailed to the same growers. They were requested to fill in these forms using the spray records collected during the summer and return them to the Simcoe office of the Ontario Ministry of Agriculture and Food.

Additional forms were added to the sample from field crop survey records which had also included data on fruit and vegetable spraying. After manual editing of forms, and removal of duplicates, about 525 records remained which were considered to be acceptable.

EDITING

All returned questionnaires were verified for a general conformity to pesticide spraying practices as outlined in the Ontario Ministry of Agriculture and Food's 1988 Vegetable [7] and Fruit [5] Production Recommendations. Pesticide specialist(s) in Simcoe, employed by the Plant Industry Branch, scrutinized the questionnaires.

EXPANDING THE SAMPLE DATA

The first step was to estimate the total use of pesticides for the province by applying appropriate raising factors to the sample data. These raising factors were calculated as the ratios of the 1988 provincial area for each fruit and vegetable crop to the corresponding area reported in the survey.

Pesticide quantities used by county and by river basin were derived employing proportional area breakdowns following the estimation of the active ingredients of each specific pesticide by commodity at the provincial level. The area distributions of these crops were obtained from the 1986 Census of Agriculture in order that township data could be assigned to river basins.

For the estimation of pesticide use on fruit and vegetable crops, the technique outlined above is preferable to that used for field crops. The main reason is that low sample sizes for fruits and vegetables in some counties can produce distorted results for those counties. More reliable results are obtained by first estimating provincial pesticide use and then allocating to counties on the basis of area grown. The assumption here is that fruit and vegetable crops are chemically treated in a somewhat similar fashion regardless of their location in the province.

As was the case with field crops, the sample occasionally had limitations in that certain pesticides or crops were not adequately represented and hence, pesticide use in such instances could not be estimated. For example, there were insufficient sample data to make separate estimates for cabbage, although it was possible to produce results for cole crops as a whole.

SUMMARY OF RESULTS

PRESENTATION

The results of the two separate surveys are presented numerically in Appendices II through XVII, and visually in Figures 2 through 8. Specific pesticides have been listed by their common names in the tables to avoid bias towards trade names. Appendix XVIII lists all the common names reported in the surveys along with their appropriate trade names.

Appendix II lists the area treated and total amount of active ingredient of each pesticide used for each field crop in the Province. Estimates of area treated were derived by dividing the total quantity of pesticides used by the corresponding rate of application as reported in the sample or equivalently, applying the appropriate raising factors to the sample area treated. These area estimates take into account multiple applications of various pesticides used on the same field.

Appendix III shows the quantity of each type of pesticide used in Ontario on field crops aggregated at the county level. The groups of pesticides include triazine herbicides, phenoxy herbicides, other herbicides, insecticides, nematocides, and growth regulators. The area of improved land in each county, extracted from the 1986 Census of Agriculture, is also presented in the table. The area of improved land consists of crop land, improved pasture, summerfallow, other cultivated land lying idle, and area of barnyards, home gardens, farm lanes and roads.

The amounts of pesticides used on field crops in the various Ontario drainage basins are presented in Appendix IV. Total land area within each basin, regardless of its agricultural, urban, or other use, was estimated to enable comparisons of pesticide use relative to different basins. The drainage basins are grouped under the lakes into which they drain. The groupings called "Lakeside Land" include the numerous small creeks which flow into each lake as well as land lying in proximity to the lakes.

Data on the quantity of active ingredients of specific pesticides used in four commonly studied watersheds were tabulated (Appendix V) to give an indication of field crop spraying in the major basins. Estimates included were for the Thames, Grand, Sydenham and Saugeen river basins.

The quantities of pesticide active ingredients of each type of chemical applied to various fruit crops in Ontario during 1988 are shown in Appendix VI. Data on the treatment of other crops such as cantaloupes and blueberries were not sufficient to warrant publication. Nursery stock spraying is also excluded. The pesticides which are used on fruit are further broken down in Appendix VIII which gives the specific pesticides used.

Appendices X and XII indicate the quantities of each type of pesticide used on fruit crops distributed according to county and river basin, respectively.

Tabulations of pesticide use on major vegetable crops, excluding greenhouse vegetables, are published in Appendix VII. Breakdowns for each specific pesticide, county level tabulations, and drainage basin estimates for vegetables are available in Appendices IX, XI, and XIII, respectively.

Total pesticide use on field crops, fruits and vegetables is summarized in Appendices XIV through XVII. Appendix XIV indicates the total area grown to major field crops, fruits, and vegetables in addition to active ingredients of each type of pesticide applied. For field crops, estimates of total area sprayed, based upon sample proportions, are also presented regardless of the number of applications.

A list of specific pesticides used on all items can be found in Appendix XV. The county and regional breakdown of pesticide types appears in Appendix XVI while Appendix XVII quantifies total agricultural pesticide use in the various drainage basins.

The data from the pesticide use surveys for field crops, fruits and vegetables were combined at the county level to estimate the approximate total amounts of each type of pesticide applied. The quantities of active ingredient used per total land area in each county were computed and are portrayed on six maps (Figures 2 to 8). These maps show the amounts of triazine, phenoxy, and other herbicides as well as insecticides, nematocides, and growth regulators in terms of application rates per hectare of total land area.

HIGHLIGHTS

Pesticide use in 1988 was most certainly affected by the extreme drought conditions experienced throughout much of Ontario. A reduction in the amounts of pesticides used compared to a normal year was at least a partial consequence of these conditions. This factor should be considered when comparing the 1988 figures to those reported in previous surveys. Highlights can be summarized as follows:

Provincial Level

Pesticides applied to agricultural crops in 1988 amounted to over 7,200 tonnes (Appendix XIV). Seventy percent of this was comprised of herbicides applied mostly to field crops, 11 percent were nematocides, 9 percent were fungicides, and 5 percent each of insecticides and growth regulators.

Triazine herbicides represented 30 percent of all herbicides used, 12 percent were phenoxy herbicides and 58 percent were herbicides other than triazine or phenoxy types (Appendix XIV). In 1983, the proportions were 42 percent, 9 percent, and 49 percent respectively.

By far, the widest application of triazine herbicides is for the treatment of field corn while phenoxy herbicides are used primarily on cereal grains. Other types of herbicides are used most often on corn, soybeans, and dry beans (Appendix XIV).

The herbicides used in largest quantities on field crops in the Province were metolachlor (1,709 tonnes) and atrazine (1,041 tonnes). Several herbicides were applied in amounts varying between 200 and 250 tonnes including metribuzin (247 tonnes), EPTC (243 tonnes), cyanazine (225 tonnes), and MCPA (222 tonnes). A number of variations in pesticide use compared to 1983 are evident. Alachlor, now removed from the market, accounted for 1,056 tonnes in 1983; atrazine use has declined from 1,720 tonnes; application of metolachlor has more than doubled from the 826 tonnes previously reported; cyanazine use has decreased from 430 tonnes; and application of EPTC has dramatically increased from 26 tonnes (Appendix II).

Total insecticide use on field crops was estimated to be 127 tonnes in 1988. Field corn, which accounted for over 70 percent of this quantity, received some 70 tonnes of terbufos and 18 tonnes of fonofos. About 15 tonnes of acephate were applied to tobacco while applications of chlorpyrifos were substantially reduced from the 14 tonnes applied in 1983 (Appendix II).

Approximately 767 tonnes of nematocides, less than half that applied in 1983, primarily mixtures of 1,3 dichloropropene plus 1,2 dichloropropane (DCP), methylisothiocyanate, and chloropicrin, were applied to tobacco. Close to 324 tonnes of the growth regulator decyl alcohol were also applied to tobacco (Appendix II).

Total amounts of pesticides used on field corn (2,585 tonnes), soybeans (1,698 tonnes), and tobacco (1,119 tonnes) accounted for 87 percent of all pesticides applied to field crops (Appendix XIV).

Almost 70 percent of all fungicides used in the Province were applied to fruit crops. Metiram was the major fungicide used on fruit (156 tonnes), followed by mancozeb (128 tonnes), and captan (71 tonnes) (Appendix VIII).

Insecticides were also significant pesticides used on fruit. Use of insecticides included phosmet (44 tonnes), azinophos-methyl (33 tonnes), and carbaryl (14 tonnes) (Appendix VIII).

Pesticides used on apples (323 tonnes), grapes (145 tonnes), and peaches (57 tonnes) represented 88 percent of all pesticides used on fruit crops (Appendix VI).

Fungicides and insecticides were the most significant pesticides used on vegetable crops. The major fungicides used were chlorothalonil (78 tonnes), mancozeb (72 tonnes), metiram (15 tonnes), maneb (14 tonnes), and captafol (12 tonnes). Parathion (12 tonnes), carbofuran (11 tonnes), carbaryl (11 tonnes), and azinophos-methyl (10 tonnes) were the most commonly used insecticides (Appendix IX). Use of nematocides on vegetable crops (29 tonnes) was limited to potatoes.

Pesticides used on potatoes (145 tonnes), tomatoes (124 tonnes), and fresh market sweet corn (24 tonnes) accounted for 74 percent of pesticides used on vegetables (Appendix VII).

County Level

Patterns of pesticide use at the county level generally reflect the distribution of the area grown to the various agricultural crops in the Province.

Southern Ontario as a region received 64 percent of all pesticides applied in the Province. On a county basis, use of pesticides was highest in Haldimand-Norfolk, Elgin, Kent, and Middlesex counties, all located in Southern Ontario (Appendix XVI).

Heaviest use of triazine herbicides was in Huron county in Western Ontario, followed closely by Middlesex, Lambton and Kent counties in Southern Ontario. Phenoxy herbicides were applied in the greatest quantity in Western Ontario, particularly in Wellington, Waterloo and Huron counties. Use of herbicides other than triazine or phenoxy was foremost in Kent, Middlesex, and Lambton counties.

Insecticide use was highest in Niagara (18 percent), where fruit production is concentrated, double the amount used in Oxford, Simcoe, and Haldimand-Norfolk counties which follow next.

Fungicides were also used to the greatest extent in Niagara (27 percent), trailed by Essex (12 percent), Haldimand-Norfolk, Grey, and Kent counties (6 percent each).

Use of nematocides was predominant in the tobacco growing counties of the Province, specifically Haldimand-Norfolk and Elgin which together accounted for 76 percent of nematocides applied. Similarly, these two counties represented 70 percent of the total amount of growth regulators used.

In terms of average rates of application (quantity of pesticide active ingredient used per hectare of total land), triazine herbicide usage was highest in the counties of Kent, Waterloo, Oxford, Huron and Lambton. Each of these counties had rates of at least 0.4 kg/ha (Figure 2).

The heaviest use of phenoxy herbicides was in Waterloo and Wellington, each of which had application rates in excess of 0.2 kg/ha (Figure 3).

Application rates for herbicides other than triazine or phenoxy types were highest in Kent, Elgin and Essex counties at over 1.0 kg/ha (Figure 4).

Insecticide use per hectare was largest in Niagara at more than 0.3 kg/ha. In Oxford, Essex, Hamilton-Wentworth and Haldimand-Norfolk, rates for insecticide applications exceeded 0.1 kg/ha (Figure 5).

Fungicide use was also highest in Niagara at over 0.9 kg/ha. Other counties having application rates for fungicides in excess of 0.15 kg/ha were Essex, Hamilton-Wentworth, Kent and Haldimand-Norfolk (Figure 6).

Again, reflecting the distribution of the area grown to tobacco, the most significant applications of nematocides (over 0.4 kg/ha) occurred in Haldimand-Norfolk, Elgin and Oxford (Figure 7). Similarly, appreciable amounts of growth regulators (over 0.15 kg/ha) were apparent in these same counties (Figure 8).

River Basin Level

During 1988, the following amounts of pesticide active ingredient were used in the four major groups of river basins that drain into the Great Lakes system: Lake Huron - 1,280 tonnes; Lake St. Clair - 1,815 tonnes; Lake Erie - 2,775 tonnes; and Lake Ontario - 909 tonnes (Appendix XVII).

By way of comparison, these estimates are each significantly less than the 1983 survey figures of 1,527, 2,093, 3,632, and 1,154 tonnes, respectively.

APPENDICES

APPENDIX I

EXAMPLES OF METHODOLOGY USED IN THE ESTIMATION OF PESTICIDE USE AT THE COUNTY AND RIVER BASIN LEVELS - FIELD CROPS

COUNTY LEVEL

The expansion factor for each crop in each county depends upon the total area of each crop in the county and the area of that crop reported in the returned questionnaires.

Example:

Elgin County:

Total area of corn in 1988 . . . . . 49,600 ha
Total area of corn reported in sample . . . . 5,380 ha

Therefore, the expansion factor for corn is: $\frac{49,600}{5,380} = 9.22$

The total quantity of active ingredient of a particular pesticide was calculated by multiplying the expansion factor for the crop treated in a county by the amount of active ingredient reported for that county in the sample.

Example:

Elgin County:

Total quantity of active ingredient of atrazine used on corn in the sample..... 5,260 kg

Therefore, the total quantity of active ingredient of atrazine used on corn in Elgin would be:

$$5,260 \times 9.22 = 48,500 \text{ kg}$$

RIVER BASIN LEVEL

Pesticide use at the drainage basin level was estimated by summing the contributions made by each county or portion of a county contained in the basin.

If a county was wholly contained within a river basin, then its contribution towards the use of a particular pesticide on a crop grown in that basin was simply the estimated quantity of active ingredient as illustrated in the previous example.

However, if a county was partially contained within a river basin, its contribution was calculated as the estimated quantity of active ingredient based only upon respondents who reside in those townships assigned to the drainage basin.

Example: (fabricated)

Suppose that a river basin is comprised of county X in its entirety, but only part of county Y. In estimating the quantity of active ingredient of atrazine applied to corn in this basin, the first step is to visually judge as best as possible those whole townships in county Y which should be assigned to the drainage basin in question. Denote these townships collectively as "region Z".

Further, suppose that:

Sample total of active ingredient of atrazine used on corn in county X is . . . . . 10,000 kg

Sample total of active ingredient of atrazine used on corn in region Z (contained within county Y) is . . . . . 5,000 kg

Expansion factor for corn in county X is 6.8

Expansion factor for corn in county Y is 8.3

Then the total quantity of active ingredient of atrazine on corn in the river basin would be estimated as:

$$(10{,}000 \times 6.8) + (5{,}000 \times 8.3) = 109{,}500 \text{ kg}$$

Note that while this estimate does not depend on the sample total of active ingredient of atrazine used on corn in county Y, the expansion factor for corn in county Y is required.

APPENDIX II - Area Treated and Total Quantities of Pesticide Active Ingredients used on Field Crops in Ontario, 1988

Pesticide Used by Crop	Area Treated	Amount Used
	ha	kg
HERBICIDES		
Field Corn		
2,4-D (p)	67,200	31,220
2,4-DB (p)	430	320
EPTC (o)	50,200	230,600
MCPA (p)	7,780	3,600
MCPB (p)	710	1,030
alachlor (o)	330	940
atrazine (t)	536,000	999,410
bentazon (o)	25,200	14,470
bromoxynil (o)	70,300	20,150
butylate (o)	46,500	105,890
cyanazine (t)	98,900	222,870
dicamba (p)	251,300	124,070
glyphosate (o)	18,000	17,210
linuron (o)	3,740	3,480
mecoprop (p)	23,300	2,190
metolachlor (o)	326,000	712,170
metribuzin (t)	1,120	690
simazine (t)	1,030	1,060
Total		2,491,370
Soybeans		
2,4-D (p)	580	340
MCPA (p)	11,000	7,430
alachlor (o)	1,130	1,190
atrazine (t)	370	350
bentazon (o)	134,000	135,300
chloramben (o)	26,100	33,030
chlorimuron-ethyl (o)	740	10
chloroxuron (o)	330	300
dicamba (p)	260	180
diquat (o)	250	130
ethalfluralin (o)	8,600	9,030
fenoxaprop-ethyl (o)	6,250	710
glyphosate (o)	75,600	41,770
linuron (o)	169,000	169,610
metobromuron (o)	25,550	27,250
metolachlor (o)	426,000	915,170
metribuzin (t)	405,000	235,250
monolinuron (o)	3,500	3,160
sethoxydim (o)	41,350	11,480
trifluralin (o)	113,000	103,080
Total		1,694,770
Field Beans		
2,4-D (p)	550	120
EPTC (o)	2,960	12,780
atrazine (t)	1,040	1,500
bentazon (o)	16,700	15,120
chloramben (o)	2,040	2,180
dicamba (p)	550	40
diquat (o)	2,810	1,710
ethalfluralin (o)	4,430	8,220
glyphosate (o)	11,300	10,490
linuron (o)	15,900	14,780
mecoprop (p)	550	30
metobromuron (o)	26,800	34,840
metolachlor (o)	40,600	81,360
metribuzin (t)	24,800	11,060
monolinuron (o)	4,600	4,070
sethoxydim (o)	7,500	1,640
trifluralin (o)	20,700	19,570
Total		219,510
HERBICIDES (cont'd)		
Tobacco		
diphenamid (o)	1,970	3,180
glyphosate (o)	450	520
maleic hydrazide (o)	70	310
napropamide (o)	2,280	1,480
pebulate (o)	430	1,920
sethoxydim (o)	50	10
Total		7,420
Grain		
2,4-D (p)	177,000	115,150
2,4-DB (p)	70,600	52,750
MCPA (p)	358,900	206,170
MCPB (p)	26,250	19,340
atrazine (t)	5,060	6,500
bromoxynil (o)	21,200	7,060
dicamba (p)	59,000	11,230
diclofop-methyl (o)	360	250
difenzoquat (o)	13,100	5,480
glyphosate (o)	69,900	60,900
mecoprop (p)	23,500	4,940
metribuzin (t)	590	140
paraquat (o)	340	30
propanil (o)	1,110	560
simazine (t)	340	110
triallate (o)	650	710
Total		491,320
Canola		
atrazine (t)	9,700	30,400
cyanazine (t)	1,090	2,310
glyphosate (o)	850	750
sethoxydim (o)	2,600	1,060
trifluralin (o)	1,000	1,160
Total		35,680
Hay & Pasture		
2,4-D (p)	3,610	2,900
2,4-DB (p)	9,970	6,080
EPTC (o)	410	110
MCPA (p)	4,260	4,970
MCPB (p)	2,710	1,890
atrazine (t)	740	2,540
dicamba (p)	730	300
diquat (o)	740	370
glyphosate (o)	26,300	24,760
paraquat (o)	350	170
trifluralin (o)	510	400
Total		44,490
INSECTICIDES		
Field Corn		
carbaryl	30	10
carbofuran	510	40
chlorpyrifos	1,620	2,460
fonofos	13,700	18,080
permethrin	50	10
phorate	3,540	3,280
terbufos	57,510	69,920
Total		93,800
Soybeans		
carbaryl	530	1,510
dimethoate	3,450	1,910
permethrin	100	10
Total		3,430
INSECTICIDES (cont'd)		
Field Beans		
dimethoate	200	70
phorate	540	760
Total		830
Tobacco		
Bacillus thuringiensis	2,590	2,330
acephate	15,100	14,570
azinophos-methyl	300	330
carbaryl	360	140
chlorpyrifos	1,780	180
cypermethrin	1,650	170
deltamethrin	7,420	90
diazinon	630	90
endosulfan	100	130
oxydemeton-methyl	11,100	680
permethrin	5,920	440
pirimicarb	1,250	520
trichlorfon	620	1,510
Total		21,180
Canola		
carbofuran	200	50
terbufos	9,030	7,480
Total		7,530
FUNGICIDES[a]		
Field Corn		
captan	1,580	260
Total		260
Tobacco		
benomyl	370	30
Total		30
Grain		
triadimefon	740	90
triazole	11,700	3,120
Total		3,210
NEMATOCIDES		
Tobacco		
chloropicrin	2,700	34,160
dichloropropenes + dichloropropanes	16,300	677,370
metam-sodium	110	3,000
methylisothiocyanate	7,620	52,280
Total		766,810
GROWTH REGULATORS		
Tobacco		
decyl alcohol	13,700	323,530
ethephon	190	80
Total		323,610
Grain		
ethephon	2,780	910
chlormequat chloride	740	420
Total		1,330
GRAND TOTAL		6,206,580

[a] Fungicides used for greenhouse and seed treatments are excluded. (p) phenoxy herbicide (t) triazine herbicide (o) other herbicide

APPENDIX III - Quantities of Active Ingredients of Each Type of Pesticide Used on Field Crops in 1988, by County and District, Ontario

Counties and Districts	Improved Area	Herbicides			Insecticides	Nematocides	Growth Regulators
		Triazine	Phenoxy	Other			
	ha				- kilograms -		
Brant	54,655	31,610	15,240	88,460	1,150	27,110	12,340
Elgin	129,383	68,160	11,250	248,460	8,900	225,430	60,590
Essex	131,395	64,110	10,220	231,320	1,590	-	-
Haldimand-Norfolk	175,520	64,640	20,210	161,990	12,780	383,670	170,230
Hamilton-Wentworth	49,425	11,020	7,530	9,160	680	-	-
Kent	209,985	116,400	23,290	333,840	4,700	14,240	24,320
Lambton	203,365	119,520	22,920	264,750	9,840	-	-
Middlesex	221,256	132,820	31,800	324,260	16,480	19,440	27,180
Niagara	83,442	28,300	7,890	29,460	-	-	-
Oxford	150,316	83,040	28,630	186,490	25,440	96,920	29,010
Southern Ontario	**1,408,742**	**719,620**	**178,980**	**1,878,190**	**81,560**	**766,810**	**323,670**
Bruce	186,691	51,160	22,620	44,450	4,240	-	-
Dufferin	64,429	37,950	16,810	700	6,550	-	-
Grey	171,618	2,210	3,730	3,880	930	-	-
Halton	36,854	13,670	7,250	90,640	-	-	-
Huron	246,697	137,230	40,790	250,140	14,160	-	-
Peel	43,371	9,010	3,260	29,490	-	-	-
Perth	177,594	82,510	22,140	183,660	8,880	-	-
Simcoe	165,964	46,410	34,890	28,370	9,240	-	430
Waterloo	83,837	58,360	41,910	74,910	890	-	-
Wellington	159,286	43,420	68,590	35,390	-	-	-
Western Ontario	**1,336,341**	**481,930**	**261,990**	**741,630**	**44,890**	-	**430**
Durham	107,275	62,710	29,120	53,840	60	-	420
Haliburton	1,637	-	-	-	-	-	-
Hastings	65,732	6,280	2,600	2,000	-	-	-
Muskoka	4,532	-	-	-	-	-	-
Northumberland	80,313	14,180	13,670	25,090	-	-	420
Parry Sound	13,385	-	-	-	-	-	-
Peterborough	62,551	2,920	1,780	370	-	-	-
Prince Edward	43,978	10,490	3,720	12,520	-	-	-
Victoria	83,649	11,350	4,280	17,850	-	-	-
York	67,294	9,550	5,100	8,330	260	-	-
Central Ontario	**530,346**	**117,480**	**60,270**	**120,000**	**320**	-	**840**
Frontenac	40,291	550	-	20	-	-	-
Lanark	48,296	2,860	1,650	180	-	-	-
Leeds & Grenville	76,413	6,440	3,150	8,130	-	-	-
Lennox & Addington	44,789	13,230	13,660	19,070	-	-	-
Ottawa-Carleton	92,614	3,340	3,540	7,690	-	-	-
Prescott & Russell	96,076	58,960	16,290	41,960	-	-	-
Renfrew	78,339	-	4,530	150	-	-	-
Stormont, Dundas & Glengarry	142,679	107,700	39,460	44,340	-	-	-
Eastern Ontario	**619,497**	**193,080**	**82,280**	**121,540**	-	-	-
Algoma	19,735	-	-	2,200	-	-	-
Cochrane	18,836	-	380	-	-	-	-
Kenora	7,441	-	1,740	4,520	-	-	-
Manitoulin	19,614	240	-	-	-	-	-
Nipissing	19,532	1,740	2,540	2,730	-	-	-
Rainy River	31,371	100	680	-	-	-	-
Sudbury	15,907	-	140	360	-	-	-
Thunder Bay	16,312	-	-	370	-	-	-
Timiskaming	51,487	-	7,290	2,540	-	-	-
Northern Ontario	**200,235**	**2,080**	**12,770**	**12,720**	-	-	-
PROVINCE	**4,095,161**	**1,514,190**	**596,290**	**2,874,080**	**126,770**	**766,810**	**324,940**

Note: Improved land area consists of cropland, improved pasture, summerfallow, other cultivated land lying idle, and area of barnyards, home gardens, farm lanes and roads (1986 Census of Agriculture).

APPENDIX IV - Quantities of Active Ingredients of Each Type of Pesticide Used on Field Crops in the Various Ontario Drainage Basins of the Great Lakes, 1988

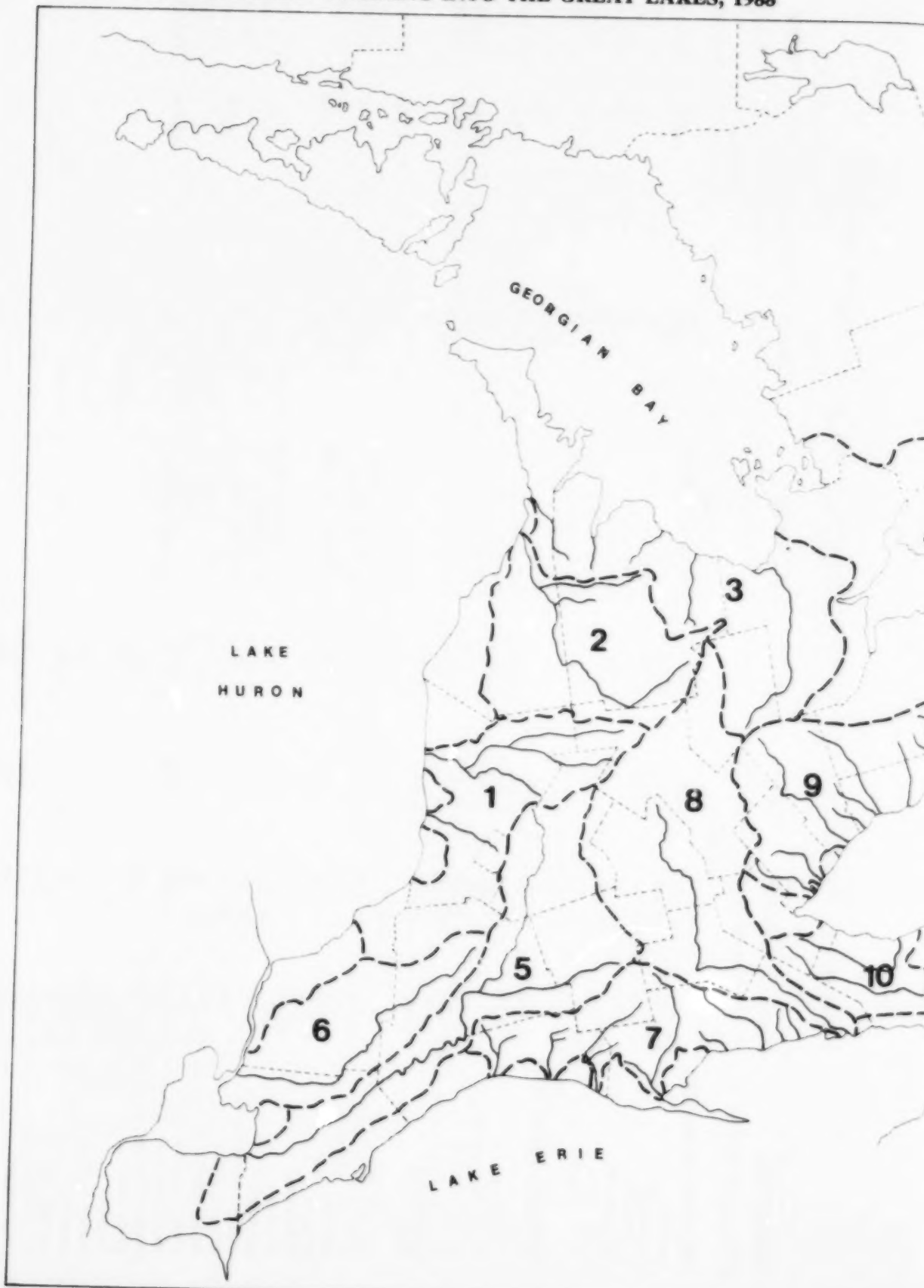
Drainage Basins	Total Area	Herbicides			Insecticides	Nematocides	Growth Regulators	Total
		Triazine	Phenoxy	Other				
	ha	- kilograms -						
LAKE HURON AND GEORGIAN BAY								
Ausable, Bayfield, Maitland	443,470	194,330	64,880	350,730	20,010	-	-	629,950
Saugeen	391,140	47,210	21,670	42,100	2,970	-	-	113,950
Nottawasaga to Owen Sound	407,550	41,570	25,580	19,990	10,170	-	430	97,740
Holland, Severn	549,910	14,900	9,210	12,120	260	-	-	36,490
Lakeside land	488,750	57,320	27,180	104,020	3,970	-	-	192,490
Total	**2,280,820**	**355,330**	**148,520**	**528,960**	**37,380**	**-**	**430**	**1,070,620**
LAKE ST. CLAIR								
Thames	594,340	274,120	70,540	733,320	31,460	75,350	82,620	1,267,410
Sydenham	315,150	108,670	17,650	229,200	10,490	-	-	366,010
lakeside land	92,770	19,140	3,920	73,500	1,030	-	-	97,590
Total	**1,002,260**	**401,930**	**92,110**	**1,036,020**	**42,980**	**75,350**	**82,620**	**1,731,010**
LAKE ERIE								
Kettle to Haldimand	301,180	99,890	27,830	351,720	26,530	634,910	228,710	1,369,590
Grand	656,810	204,990	136,210	258,480	16,670	56,550	12,340	685,240
Lakeside land	311,200	107,390	18,650	321,910	2,470	-	-	450,420
Total	**1,269,190**	**412,270**	**182,690**	**932,110**	**45,670**	**691,460**	**241,050**	**2,505,250**
LAKE ONTARIO								
Oakville to Pickering	352,570	32,000	14,810	125,020	-	-	420	172,250
Welland, West Lincoln	178,730	17,910	10,270	8,960	680	-	-	37,820
Trent	1,050,840	24,710	21,120	38,630	-	-	420	84,880
Moira to Gananoque	676,910	12,270	6,910	7,160	-	-	-	26,340
Lakeside land	865,640	74,360	31,840	75,100	60	-	-	181,360
Total	**3,124,690**	**161,250**	**84,950**	**254,870**	**740**	**-**	**840**	**502,650**
Total of Above	**7,676,960**	**1,330,780**	**508,270**	**2,751,960**	**126,770**	**766,810**	**324,940**	**5,809,530**
Remainder of Province	84,066,380	183,410	88,020	122,120	-	-	-	393,550
Total Province	**91,743,340**	**1,514,190**	**596,290**	**2,874,080**	**126,770**	**766,810**	**324,940**	**6,203,080**

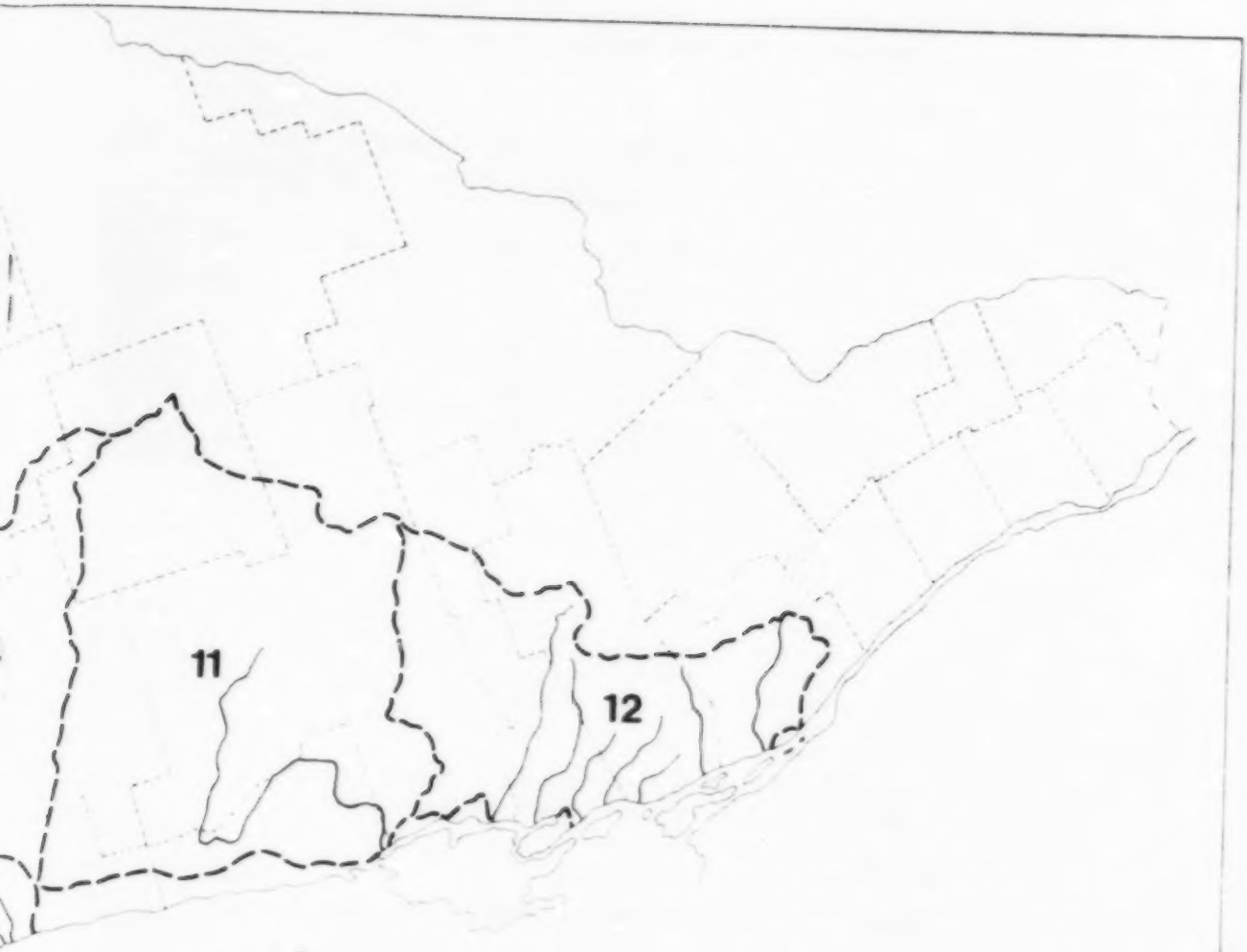
APPENDIX V - Quantities of Specific Pesticide Active Ingredients Used on Field Crops in Four Major Ontario Drainage Basins, 1988

Pesticide Used	Thames	Sydenham	Grand	Saugeen
		- kilograms -		
TRIAZINE HERBICIDES				
atrazine	189,910	52,970	177,070	35,400
cyanazine	30,650	14,130	20,560	8,090
metribuzin	52,670	41,570	7,360	3,720
simazine	890	-	-	-
Total	**274,120**	**108,670**	**204,990**	**47,210**
PHENOXY HERBICIDES				
2,4-D	16,680	5,980	27,170	
2,4-DB	6,080	-	9,380	4,770
MCPA	12,420	7,380	53,920	8,090
MCPB	1,660	320	3,170	-
dicamba	32,590	3,550	42,570	2,820
mecoprop	1,110	420	-	340
Total	**70,540**	**17,650**	**136,210**	**21,670**
OTHER HERBICIDES				
EPTC	93,600	850	35,220	-
alachlor	690	-	-	-
bentazon	37,190	4,680	8,120	520
bromoxynil	5,990	820	3,980	1,030
butylate	23,930	5,070	7,490	-
chloramben	7,090	2,290	290	9,620
diclofop-methyl	-	-	250	-
difenzoquat	630	-	1,430	390
diphenamid	-	-	360	-
diquat	140	50	-	-
ethalfluralin	9,240	1,800	230	-
fenoxaprop-ethyl	120	-	40	-
glyphosate	26,010	10,820	20,540	5,020
linuron	55,890	13,560	16,370	990
maleic hydrazide	310	-	-	-
metobromuron	8,600	1,110	-	200
metolachlor	435,320	186,830	161,530	22,380
monolinuron	1,230	490	-	-
napropamide	320	-	560	-
sethoxydim	2,070	210	920	260
trifluralin	24,950	620	1,150	1,690
Total	**733,320**	**229,200**	**258,480**	**42,100**

Pesticide Used	Thames	Sydenham	Grand	Saugeen
		- kilograms -		
INSECTICIDES				
Bacillus thuringiensis	520	-	-	-
acephate	2,270	-	1,230	-
azinophos-methyl	330	-	-	-
carbofuran	40	-	60	-
chlorpyrifos	1,190	560	80	-
cypermethrin	30	-	10	-
deltamethrin	20	-	10	-
dimethoate	500	-	-	-
fonofos	7,030	4,500	510	-
permethrin	30	-	10	-
phorate	2,290	-	230	-
pirimicarb	90	-	-	-
terbufos	17,120	5,430	14,530	2,970
Total	**31,460**	**10,490**	**16,670**	**2,970**
NEMATOCIDES				
chloropicrin	-	-	4,940	-
dichloropropenes + dichloropropanes	63,480	-	51,610	-
methylisothiocyanate	11,870	-	-	-
Total	**75,350**	**-**	**56,550**	**-**
GROWTH REGULATORS				
decyl alcohol	82,560	-	12,340	-
ethephon	60	-	-	-
Total	**82,620**	**-**	**12,340**	**-**
GRAND TOTAL	**1,267,410**	**366,010**	**685,240**	**113,950**

FIGURE 1: RIVER BASINS DRAINING INTO THE GREAT LAKES, 1988





LIST OF RIVER BASINS DRAINING INTO THE GREAT LAKES

LAKE HURON AND GEORGIAN BAY

1. AUSABLE RIVER, BAYFIELD RIVER AND MAITLAND RIVER
2. SAUGEEN RIVER
3. NOTTAWASAGA RIVER, SAUBLE RIVER, BIG HEAD RIVER, BEAVER RIVER AND OWEN SOUND LAKEFRONT
4. HOLLAND RIVER AND SEVERN RIVER

LAKE ST. CLAIR

5. THAMES RIVER
6. SYDENHAM RIVER

LAKE ERIE

7. KETTLE CREEK, CATFISH CREEK, BIG OTTER CREEK, BIG CREEK, LYNNE RIVER AND HALDIMAND LAKEFRONT
8. GRAND RIVER

LAKE ONTARIO

9. OAKVILLE CREEK, BRONTE CREEK, CREDIT RIVER, ETOBICOKE CREEK, MIMICO CREEK, HUMBER RIVER, TORONTO EAST LAKEFRONT, PICKERING LAKEFRONT
10. WELLAND RIVER AND WEST LINCOLN LAKEFRONT
11. TRENT RIVER
12. MOIRA RIVER, SALMON RIVER, NAPANEE RIVER, WILTON CREEK, MILLHAVEN CREEK, COLLINS CREEK, CATARAQUI RIVER AND GANANOQUE RIVER

APPENDIX VI - Quantities of Pesticide Active Ingredients of Each Type of Pesticide Used on Fruit Varieties in Ontario, 1988

Crop	Area Grown	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total
		Triazine	Phenoxy	Other					
	hectares	- kilograms -							
Apples	10,969	2,310	20	2,240	245,580	71,250	300	1,110	322,810
Cherries	1,204	-	-	150	10,160	3,730	-	130	14,170
Grapes	9,341	3,420	-	4,920	106,560	30,220	-	90	145,210
Peaches	3,154	-	-	1,300	34,150	21,520	-	-	56,970
Pears	1,426	500	-	740	14,570	9,750	-	-	25,560
Plums	689	-	-	230	14,140	2,520	-	-	16,890
Raspberries	487	230	-	560	550	490	-	-	1,830
Strawberries	1,740	-	420	2,500	3,900	4,870	3,430	-	15,120
Total	**29,010**	**6,460**	**440**	**12,640**	**429,610**	**144,350**	**3,730**	**1,330**	**598,560**

APPENDIX VII - Quantities of Pesticide Active Ingredients of Each Type of Pesticide Used on Vegetable Varieties in Ontario, 1988

Crop	Area Grown	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total
		Triazine	Phenoxy	Other					
	hectares	- kilograms -							
Asparagus	1,526	920	270	2,530	1,230	3,070	-	-	8,020
Beans	3,787	-	-	8,780	-	-	-	-	8,780
Carrots	2,511	160	-	1,300	8,040	7,030	-	-	16,530
Cole crops	4,436	-	-	2,850	620	3,690	-	-	7,160
Cucumbers	2,054	-	-	2,840	1,540	890	-	-	5,270
Lettuce	713	-	-	20	910	2,600	-	-	3,530
Onions	2,187	-	-	1,030	9,860	7,770	-	-	18,660
Peas	8,328	-	2,130	5,400	-	430	-	-	7,960
Peppers	1,680	-	-	6,730	3,100	1,970	-	-	11,800
Potatoes	13,927	5,280	110	16,140	69,420	25,360	28,920	-	145,230
Pumpkin/Squash	585	-	100	560	-	220	-	-	880
Rutabagas	1,393	-	-	1,680	-	5,960	-	-	7,640
Sweet Corn[a]	7,438	5,940	260	10,380	30	7,080	-	-	23,690
Tomatoes	15,004	5,030	-	7,460	98,220	9,780	-	3,200	123,690
Other Vegs.	365	860	-	520	3,490	2,620	-	-	7,490
Total	**65,934**	**18,190**	**2,870**	**68,220**	**196,460**	**78,470**	**28,920**	**3,200**	**396,330**

[a] Refers to the fresh market crop only.

APPENDIX VIII - Quantities of Specific Pesticide Active Ingredients Used on All Fruit in Ontario, 1988

Pesticide Used	Quantity
HERBICIDES	kilograms
2,4-D (p)	410
MCPA (p)	10
MCPB (p)	20
amino triazole + ammonium thiocyanate (o)	210
atrazine (t)	80
bentazon (o)	230
chloramben (o)	360
chlorothal-methyl (o)	400
chloroxuron (o)	270
dichlobenil (o)	500
diuron (o)	1,720
fluazifop-butyl (o)	20
glyphosate (o)	1,340
linuron (o)	1,090
metolachlor (o)	90
napropamide (o)	870
paraquat (o)	3,330
sethoxydim (o)	30
simazine (t)	6,380
terbacil (o)	1,250
trifluralin (o)	930
Total	**19,540**
FUNGICIDES	
benomyl	1,180
captafol	840
captan	71,140
chlorthalonil	210
dichlone	1,780
dodine	5,430
ferbam	6,970
fixed copper	1,500
folpet	10,080
iprodione	2,120
mancozeb	127,710
metiram	155,720
streptomycin sulfate	70
sulphur	44,520
thiophanate-methyl	30
trifor	160
zineb	150
Total	**429,610**

Pesticide Used	Quantity
INSECTICIDES	kilograms
Bacillus thuringiensis	1,420
DNOC	360
azinophos methyl	32,650
carbaryl	14,250
carbofuran	1,460
chinomethionat	1,460
cyhexatin	660
cypermethrin	390
deltamethrin	20
diazinon	2,840
dicofol	5,960
dimethoate	320
dinocap	8,410
endosulfan	4,790
ethion	300
fenvalerate	40
formetanate hydrochloride	1,160
malathion	2,350
methidathion	480
methomyl	1,220
oxamyl	10
parathion	2,980
permethrin	60
phosalone	8,830
phosmet	44,180
pirimicarb	390
propargite	7,360
Total	**144,350**
NEMATOCIDES	
chloropicrin	630
dichloropropanes + dichloropropenes	3,000
methylisothiocyanate	100
Total	**3,730**
GROWTH REGULATORS	
daminozide	1,250
ethephon	80
Total	**1,330**
GRAND TOTAL	**598,560**

APPENDIX IX - Quantities of Specific Active Ingredients Used on All Vegetables in Ontario, 1988

Pesticide Used	Quantity
HERBICIDES	kilograms
2,4-D (p)	580
EPTC (o)	4,870
MCPA (p)	10
MCPB (p)	2,130
alachlor (o)	50
atrazine (t)	4,330
bentazon (o)	2,430
bromoxynil (o)	320
butylate (o)	550
chloramben (o)	7,310
chlorothal-methyl (o)	200
chlorpropham (o)	180
cyanazine (t)	1,610
dicamba (p)	140
dinoseb (o)	90
diphenamid (o)	470
diquat (o)	890
diuron (o)	1,050
glyphosate (o)	940
ioxynil (o)	10
linuron (o)	4,230
maleic hydrazide (o)	3,790
mecoprop (p)	10
metobromuron (o)	390
metolachlor (o)	15,910
metribuzin (t)	10,920
monolinuron (o)	5,580
naptalam (o)	2,760
oxyflurofen (o)	100
paraquat (o)	450
prometryne (t)	1,020
sethoxydim (o)	1,980
simazine (t)	310
trifluralin (o)	13,670
Total	**89,280**
FUNGICIDES	
anilazine	30
captafol	12,400
captan	10
chlorthalonil	78,260
fixed copper	2,770
mancozeb	72,400
maneb	13,670
metiram	15,120
thiophanate-methyl	740
thiram	400
zineb	660
Total	**196,460**

Pesticide Used	Quantity
INSECTICIDES	kilograms
Bacillus thuringiensis	1,060
aldicarb	3,260
azinophos-methyl	10,140
carbaryl	11,140
carbofuran	11,020
chlorfenvinphos	1,270
chlorpyrifos	760
cypermethrin	480
deltamethrin	80
demeton	410
diazinon	2,500
dimethoate	870
endosulfan	9,100
fensulfothion	2,910
fonofos	290
malathion	2,470
methamidophos	1,910
methidathion	1,840
methoxychlor	50
mevinphos	50
naled	1,580
parathion	11,830
permethrin	1,060
phosmet	1,670
pirimicarb	200
terbufos	520
Total	**78,470**
NEMATOCIDES	
dichloropropanes + dichloropropenes	28,920
Total	**28,920**
GROWTH REGULATORS	
ethephon	3,200
Total	**3,200**
GRAND TOTAL	**396,330**

APPENDIX X - Quantities of Active Ingredients of Each Type of Pesticide Used on Fruit Crops in 1988, by County and District, Ontario

Counties and Districts	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total
	Triazine	Phenoxy	Other					
					- kilograms -			
Brant	40	10	100	4,360	1,390	70	20	5,990
Elgin	160	10	230	15,110	4,670	100	60	20,340
Essex	300	10	520	27,000	8,810	100	90	36,830
Haldimand-Norfolk	280	50	600	29,040	9,160	420	130	39,680
Hamilton-Wentworth	380	20	670	21,420	7,060	190	70	29,810
Kent	80	10	200	7,060	2,470	80	30	9,930
Lambton	80	10	160	6,730	2,250	60	30	9,320
Middlesex	100	20	210	10,010	3,150	130	40	13,660
Niagara	3,510	30	6,570	165,630	60,610	240	240	236,830
Oxford	100	10	150	10,790	3,240	80	50	14,420
Southern Ontario	**5,030**	**180**	**9,410**	**297,150**	**102,810**	**1,470**	**760**	**416,810**
Bruce	10	10	60	790	310	60	-	1,240
Dufferin	-	-	10	210	70	10	-	300
Grey	400	10	440	41,650	12,180	120	190	54,990
Halton	70	10	160	5,670	1,890	110	20	7,930
Huron	40	10	90	3,640	1,210	60	20	5,070
Peel	90	20	220	8,830	2,820	160	40	12,180
Perth	10	-	20	600	200	20	-	850
Simcoe	110	20	280	9,780	3,080	210	40	13,520
Waterloo	30	10	100	2,360	810	90	10	3,410
Wellington	30	10	110	2,260	780	90	10	3,290
Western Ontario	**790**	**100**	**1,490**	**75,790**	**23,350**	**930**	**330**	**102,780**
Durham	180	20	310	16,000	4,920	150	70	21,650
Haliburton	-	-	-	-	-	-	-	-
Hastings	30	10	80	3,170	990	60	10	4,350
Muskoka	-	-	-	-	-	-	-	-
Northumberland	240	10	290	24,380	7,230	100	110	32,360
Parry Sound	-	-	10	60	30	10	-	110
Peterborough	10	10	70	140	120	70	-	420
Prince Edward	10	10	80	320	210	80	-	710
Victoria	10	10	60	200	130	60	-	470
York	30	20	170	2,280	860	160	10	3,530
Central Ontario	**510**	**90**	**1,070**	**46,550**	**14,490**	**690**	**200**	**63,600**
Frontenac	-	-	20	420	140	20	-	600
Lanark	-	-	30	210	100	30	-	370
Leeds & Granville	30	10	80	2,550	810	60	10	3,550
Lennox & Addington	10	10	40	390	160	40	-	650
Ottawa-Carleton	30	30	200	1,940	810	210	10	3,230
Prescott & Russell	-	10	60	300	170	70	-	610
Renfrew	20	-	60	480	200	40	-	800
Stormont, Dundas & Glengarry	40	10	90	3,590	1,120	70	20	4,940
Eastern Ontario	**130**	**70**	**580**	**9,880**	**3,510**	**540**	**40**	**14,750**
Algoma	-	-	20	80	50	20	-	170
Cochrane	-	-	10	10	10	10	-	40
Kenora	-	-	-	-	-	-	-	-
Manitoulin	-	-	-	50	10	-	-	60
Nipissing	-	-	10	20	20	10	-	60
Rainy River	-	-	-	-	10	-	-	10
Sudbury	-	-	10	20	20	20	-	70
Thunder Bay	-	-	20	30	40	20	-	110
Timiskaming	-	-	20	30	30	20	-	100
Northern Ontario	-	-	**90**	**240**	**190**	**100**	-	**620**
PROVINCE	**6,460**	**440**	**12,640**	**429,610**	**144,350**	**3,730**	**1,330**	**598,560**

APPENDIX XI - Quantities of Active Ingredients of Each Type of Pesticide Used on Vegetable Crops in 1988, by County and District, Ontario

Counties and Districts	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total
	Triazine	Phenoxy	Other					
	- kilograms -							
Brant	370	20	2,380	4,660	1,570	1,040	60	10,100
Elgin	600	110	2,340	5,500	2,000	1,280	70	11,900
Essex	3,200	480	11,030	51,040	9,070	2,350	1,400	78,570
Haldimand-Norfolk	1,360	180	6,530	14,350	5,320	590	340	28,670
Hamilton-Wentworth	460	40	2,690	5,220	2,950	1,510	30	12,900
Kent	2,030	560	9,650	33,790	6,000	150	1,000	53,180
Lambton	790	20	2,150	8,990	4,230	2,010	60	18,250
Middlesex	1,460	70	3,100	1,200	3,250	230	10	9,320
Niagara	200	10	640	2,190	940	70	50	4,100
Oxford	170	100	2,610	1,530	1,250	220	30	5,910
Southern Ontario	**10,640**	**1,590**	**43,120**	**128,470**	**36,580**	**9,450**	**3,050**	**232,900**
Bruce	40	10	160	190	110	60	-	570
Dufferin	770	20	2,370	10,120	3,710	4,190	-	21,180
Grey	70	10	190	490	250	180	-	1,190
Halton	60	10	610	400	320	510	-	1,460
Huron	290	260	2,140	1,140	3,690	460	-	7,980
Peel	130	10	450	1,010	440	300	10	2,350
Perth	370	190	1,460	10	1,750	-	-	3,780
Simcoe	2,450	50	7,060	30,870	15,100	10,240	10	65,780
Waterloo	140	10	420	1,320	590	520	-	3,000
Wellington	100	10	320	900	420	350	-	2,100
Western Ontario	**4,420**	**580**	**15,180**	**46,450**	**26,380**	**16,350**	**30**	**109,390**
Durham	730	340	2,530	2,100	1,780	670	10	8,160
Haliburton	-	-	-	-	-	-	-	-
Hastings	120	10	250	150	200	40	-	770
Muskoka	-	-	-	10	10	-	-	20
Northumberland	520	270	1,690	650	950	140	10	4,230
Parry Sound	10	-	40	140	50	60	-	300
Peterborough	60	-	120	140	110	30	-	460
Prince Edward	460	30	890	1,940	700	30	60	4,110
Victoria	80	10	210	90	170	-	-	560
York	600	20	2,510	12,110	9,560	710	30	25,540
Central Ontario	**2,580**	**680**	**8,240**	**17,330**	**13,530**	**1,680**	**110**	**44,150**
Frontenac	10	-	30	40	30	10	-	120
Lanark	10	-	30	50	30	20	-	140
Leeds & Grenville	70	10	180	190	140	30	-	620
Lennox & Addington	30	-	90	190	80	20	-	410
Ottawa-Carleton	80	10	310	470	320	90	10	1,290
Prescott & Russell	30	-	80	40	50	-	-	200
Renfrew	20	-	60	130	60	50	-	320
Stormont, Dundas & Glengarry	40	-	110	80	70	-	-	300
Eastern Ontario	**290**	**20**	**890**	**1,190**	**780**	**220**	**10**	**3,400**
Algoma	20	-	40	60	50	20	-	190
Cochrane	20	-	90	320	160	120	-	710
Kenora	-	-	-	10	-	-	-	10
Manitoulin	-	-	-	-	-	-	-	-
Nipissing	20	-	60	180	70	80	-	410
Rainy River	10	-	30	120	50	50	-	260
Sudbury	100	-	320	1,280	480	520	-	2,700
Thunder Bay	80	-	240	1,010	370	420	-	2,120
Timiskaming	10	-	10	40	20	10	-	90
Northern Ontario	**260**	**-**	**790**	**3,020**	**1,200**	**1,220**	**-**	**6,490**
PROVINCE	**18,190**	**2,870**	**68,220**	**196,460**	**78,470**	**28,920**	**3,200**	**396,330**

APPENDIX XII - Quantities of Active Ingredients of Each Type of Pesticide Used on Fruit Crops in the Various Ontario Drainage Basins of the Great Lakes, 1988

Drainage Basins	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total
	Triazine	Phenoxy	Other					
LAKE HURON AND GEORGIAN BAY								
Ausable, Bayfield, Maitland	30	-	50	3,310	1,050	20	10	4,470
Saugeen	-	-	10	110	50	10	-	180
Nottawasaga to Owen Sound	500	10	550	51,520	15,040	130	230	67,980
Holland, Severn	10	10	70	1,210	430	70	10	1,810
Lakeside Land	50	20	180	5,560	1,970	130	20	7,930
Total	**590**	**40**	**860**	**61,710**	**18,540**	**360**	**270**	**82,370**
LAKE ST. CLAIR								
Thames	140	30	360	14,730	4,820	270	60	20,410
Sydenham	10	-	10	960	290	-	10	1,280
Lakeside Land	10	10	30	550	200	30	-	830
Total	**160**	**40**	**400**	**16,240**	**5,310**	**300**	**70**	**22,520**
LAKE ERIE								
Kettle to Haldimand	420	50	730	42,960	13,250	430	190	58,030
Grand	100	30	310	9,040	2,990	250	40	12,760
Lakeside Land	300	10	540	29,010	9,420	120	100	39,500
Total	**820**	**90**	**1,580**	**81,010**	**25,660**	**800**	**330**	**110,290**
LAKE ONTARIO								
Oakville to Pickering	220	60	610	19,110	6,330	490	80	26,900
Welland, West Lincoln	2,320	20	4,050	103,920	36,710	190	180	147,390
Trent	270	30	450	26,230	7,940	240	120	35,280
Moira to Gananoque	-	-	-	30	10	-	-	40
Lakeside Land	1,940	70	3,910	111,890	40,180	580	240	158,810
Total	**4,750**	**180**	**9,020**	**261,180**	**91,170**	**1,500**	**620**	**368,420**
Total of Above	**6,320**	**350**	**11,860**	**420,140**	**140,680**	**2,960**	**1,290**	**583,600**
Remainder of Province	140	90	780	9,470	3,670	770	40	14,960
Total Province	**6,460**	**440**	**12,640**	**429,610**	**144,350**	**3,730**	**1,330**	**598,560**

APPENDIX XIII - Quantities of Active Ingredients of Each Type of Pesticide Used on Vegetable Crops in the Various Ontario Drainage Basins of the Great Lakes, 1988

Drainage Basins	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total
	Triazine	Phenoxy	Other					
LAKE HURON AND GEORGIAN BAY								
Ausable, Bayfield, Maitland	300	240	2,820	920	6,140	370	-	10,790
Saugeen	30	-	60	10	50	-	-	150
Nottawasaga to Owen Sound	2,300	100	6,990	27,470	10,670	11,300	-	58,830
Holland,Severn	1,100	10	3,270	18,630	16,260	870	-	40,140
Lakeside land	560	20	1,830	8,190	4,270	2,380	-	17,250
Total	**4,290**	**370**	**14,970**	**55,220**	**37,390**	**14,920**	**-**	**127,160**
LAKE ST. CLAIR								
Thames	3,370	870	11,090	31,460	6,880	40	970	54,680
Sydenham	180	70	530	1,890	330	10	60	3,070
Lakeside land	400	290	1,520	1,250	660	-	40	4,160
Total	**3,950**	**1,230**	**13,140**	**34,600**	**7,870**	**50**	**1,070**	**61,910**
LAKE ERIE								
Kettle to Haldimand	1,950	280	8,390	19,110	6,690	1,740	410	38,570
Grand	1,330	50	5,660	15,440	5,780	5,220	80	33,560
Lakeside land	3,230	350	14,180	54,510	10,590	2,580	1,450	86,890
Total	**6,510**	**680**	**28,230**	**89,060**	**23,060**	**9,540**	**1,940**	**159,020**
LAKE ONTARIO								
Oakville to Pickering	470	40	2,190	2,710	1,460	470	50	7,390
Welland,West Lincoln	100	10	320	1,020	270	60	30	1,810
Trent	860	160	1,970	1,110	1,390	360	10	5,860
Moira to Gananoque	30	-	50	90	50	10	-	230
Lakeside land	1,390	350	5,560	8,340	4,840	1,930	90	22,500
Total	**2,850**	**560**	**10,090**	**13,270**	**8,010**	**2,830**	**180**	**37,790**
Total of Above	**17,600**	**2,840**	**66,430**	**192,150**	**76,330**	**27,340**	**3,190**	**385,880**
Remainder of Province	590	30	1,790	4,310	2,140	1,580	10	10,450
Total Province	**18,190**	**2,870**	**68,220**	**196,460**	**78,470**	**28,920**	**3,200**	**396,330**

APPENDIX XIV - Area Grown and Sprayed, and Quantities of Active Ingredients of Pesticides Used on Field Crops, Fruits and Vegetables in Ontario, 1988

Crop	Area Grown	Area Sprayed	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total	% of Total Pesticides
			Triazine	Phenoxy	Other						
	- '000 ha -					- tonnes -					%
Corn	858.0	832.3	1,224.0	162.4	1,104.9	0.3	93.8	-	-	2,585.4	35.9
Soybeans	518.0	499.9	235.6	8.0	1,451.2	-	3.4	-	-	1,698.2	23.6
Dry Beans	53.4	49.6	12.6	0.2	206.8	-	0.8	-	-	220.4	3.1
Tobacco	24.3	24.3	-	-	7.4	-	21.2	766.8	323.6	1,119.0	15.5
Grain[a]	842.7	566.3	6.8	409.6	75.0	3.2	-	-	1.3	495.9	6.9
Canola	26.3	25.6	32.7	-	3.0	-	7.5	-	-	43.2	0.6
Hay & Pasture	1,477.0	62.0	2.5	16.1	25.8	-	-	-	-	44.4	0.6
Fruit	29.0	n/a	6.5	0.4	12.6	429.6	144.4	3.7	1.3	598.5	8.3
Vegetables	65.9	n/a	18.2	2.9	68.2	196.5	78.5	28.9	3.2	396.4	5.5
Total	3,894.6	n/a	1,538.9	599.6	2,954.9	629.6	349.6	799.4	329.4	7,201.4	100.0
% in Category			21.4	8.3	41.0	8.7	4.9	11.1	4.6	100.0	

a Includes spring and winter wheat, barley, oats, rye and mixed grain.
n/a Not available.
Note: Estimates of total area sprayed shown above do not take into account multiple applications on the same field.

APPENDIX XV - Quantities of Specific Pesticide Active Ingredients Used on Field Crops, Fruits and Vegetables in Ontario, 1988

Pesticide Used	Quantity	Pesticide Used	Quantity	Pesticide Used	Quantity
	kilograms		kilograms		kilograms
HERBICIDES		FUNGICIDES		INSECTICIDES (cont'd)	
2,4-D (p)	150,720	anilazine	30	methidathion	2,320
2,4-DB (p)	59,150	benomyl	1,210	methomyl	1,220
EPTC (o)	248,360	captafol	13,240	methoxychlor	50
MCPA (p)	222,190	captan	71,410	mevinphos	50
MCPB (p)	24,410	chlorothalonil	78,470	naled	1,580
alachlor (o)	2,180	dichlone	1,780	oxamyl	10
amino triazole + ammonium thiocyanate (o)	210	dodine	5,430	oxydemeton-methyl	680
atrazine (t)	1,045,110	ferbam	6,970	parathion	14,810
bentazon (o)	167,550	fixed copper	4,270	permethrin	1,580
bromoxynil (o)	27,530	folpet	10,080	phorate	4,040
butylate (o)	106,440	iprodione	2,120	phosalone	8,830
chloramben (o)	42,880	mancozeb	200,100	phosmet	45,850
chlorimuron-ethyl (o)	10	maneb	13,670	pirimicarb	1,110
chlorothal-methyl (o)	600	metiram	170,840	propargite	7,360
chloroxuron (o)	570	streptomycin sulfa	70	terbufos	77,920
chlorpropham (o)	180	sulphur	44,520	trichlorfon	1,510
cyanazine (t)	226,790	thiophanate-methyl	770	**Total**	**349,590**
dicamba (p)	135,960	thiram	400		
dichlobenil (o)	500	triadimefon	90	NEMATOCIDES	
diclofop-methyl (o)	250	triazole	3,120	chloropicrin	34,790
difenzoquat (o)	5,480	triforine	160	dichloropropenes + dichloropropanes	709,290
dinoseb (o)	90	zineb	810	metam-sodium	3,000
diphenamid (o)	3,650	**Total**	**629,570**	methylisothiocyanate	52,380
diquat (o)	3,100			**Total**	**799,460**
diuron (o)	2,770	INSECTICIDES			
ethalfluralin (o)	17,250	Bacillus thuringiensis	4,810	GROWTH REGULATORS	
fenoxaprop-ethyl (o)	710	DNOC	360	chlormequat chloride	420
fluazifop-butyl (o)	20	acephate	14,570	daminozide	1,250
glyphosate (o)	158,680	aldicarb	3,260	decyl alcohol	323,530
ioxynil (o)	10	azinphos methyl	43,120	ethephon	4,270
linuron (o)	193,190	carbaryl	27,050	**Total**	**329,470**
maleic hydrazide (o)	4,100	carbofuran	12,570		
mecoprop (p)	7,170	chinomethionat	1,460		
metobromuron (o)	62,480	chlorfenvinphos	1,270		
metolachlor (o)	1,724,700	chlorpyrifos	3,400	**GRAND TOTAL**	**7,201,470**
metribuzin (t)	258,060	cyhexatin	660		
monolinuron (o)	12,810	cypermethrin	1,040		
napropamide (o)	2,350	deltamethrin	190		
naptalam (o)	2,760	demeton	410		
oxyflurofen (o)	100	diazinon	5,430		
paraquat (o)	3,980	dicofol	5,960		
pebulate (o)	1,920	dimethoate	3,170		
prometryne (t)	1,020	dinocap	8,410		
propanil (o)	560	endosulfan	14,020		
sethoxydim (o)	16,200	ethion	300		
simazine (t)	7,860	fensulfothion	2,910		
terbacil (o)	1,250	fenvalerate	40		
triallate (o)	710	fonofos	18,370		
trifluralin (o)	138,810	formetanate hydrochloride	1,160		
Total	**5,093,380**	malathion	4,820		
		methamidophos	1,910		

(t) triazine herbicide
(p) phenoxy herbicide
(o) other herbicide

APPENDIX XVI - Quantities of Active Ingredients of Each Type Pesticide Used on Field Crops, Fruits and Vegetables, by County and District, Ontario, 1988

Counties and Districts	Herbicides			Fungicides[a]	Insecticides	Nematocides	Growth Regulators	Total
	Triazine	Phenoxy	Other					
	- kilograms -							
Brant	32,020	15,270	90,940	9,020	4,110	28,220	12,420	192,000
Elgin	68,920	11,370	251,030	20,610	15,570	226,810	60,720	655,030
Essex	67,610	10,710	242,870	78,040	19,470	2,450	1,490	422,640
Haldimand-Norfolk	66,280	20,440	169,120	43,390	27,260	384,680	170,700	881,870
Hamilton-Wentworth	11,860	7,590	12,520	26,640	10,690	1,700	100	71,100
Kent	118,510	23,860	343,690	40,850	13,170	14,470	25,350	579,900
Lambton	120,390	22,950	267,060	15,720	16,320	2,070	90	444,600
Middlesex	134,380	31,890	327,570	11,210	22,880	19,800	27,230	574,960
Niagara	32,010	7,930	36,670	167,820	61,550	310	290	306,580
Oxford	83,310	28,740	189,250	12,320	29,930	97,220	29,090	469,860
Southern Ontario	**735,290**	**180,750**	**1,930,720**	**425,620**	**220,950**	**777,730**	**327,480**	**4,598,540**
Bruce	51,210	22,640	44,670	980	4,660	120	-	124,280
Dufferin	38,720	16,830	3,080	10,330	10,330	4,200	-	83,490
Grey	2,680	3,750	4,510	42,140	13,360	300	190	66,930
Halton	13,800	7,270	91,410	6,070	2,210	160	30	120,950
Huron	137,560	41,060	252,370	4,780	19,060	520	20	455,370
Peel	9,230	3,290	30,160	9,840	3,260	460	50	56,290
Perth	82,890	22,330	185,140	610	10,830	20	-	301,820
Simcoe	48,970	34,960	35,710	40,650	27,420	10,450	480	198,640
Waterloo	58,530	41,930	75,430	3,680	2,290	610	10	182,480
Wellington	43,550	68,610	35,820	3,160	1,200	440	10	152,790
Western Ontario	**487,140**	**262,670**	**758,300**	**122,240**	**94,620**	**17,280**	**790**	**1,743,040**
Durham	63,620	29,480	56,680	18,100	6,760	820	500	175,960
Haliburton	-	-	-	-	-	-	-	-
Hastings	6,430	2,620	2,330	3,320	1,190	100	10	16,000
Muskoka	-	-	-	10	10	-	-	20
Northumberland	14,940	13,950	27,070	25,030	8,180	240	540	89,950
Parry Sound	10	-	50	200	80	70	-	410
Peterborough	2,990	1,790	560	280	230	100	-	5,950
Prince Edward	10,960	3,760	13,490	2,260	910	110	60	31,550
Victoria	11,440	4,300	18,120	290	300	60	-	34,510
York	10,180	5,140	11,010	14,390	10,680	870	40	52,310
Central Ontario	**120,570**	**61,040**	**129,310**	**63,880**	**28,340**	**2,370**	**1,150**	**406,660**
Frontenac	560	-	70	460	170	30	-	1,290
Lanark	2,870	1,650	240	260	130	50	-	5,200
Leeds & Grenville	6,540	3,170	8,390	2,740	950	90	10	21,890
Lennox & Addington	13,270	13,670	19,200	580	240	60	-	47,020
Ottawa-Carleton	3,450	3,580	8,200	2,410	1,130	300	20	19,090
Prescott & Russell	58,990	16,300	42,100	340	220	70	-	118,020
Renfrew	40	4,530	270	610	260	90	-	5,800
Stormont, Dundas & Glengarry	107,780	39,470	44,540	3,670	1,190	70	20	196,740
Eastern Ontario	**193,500**	**82,370**	**123,010**	**11,070**	**4,290**	**760**	**50**	**415,050**
Algoma	20	-	2,260	140	100	40	-	2,560
Cochrane	20	380	100	330	170	130	-	1,130
Kenora	-	1,740	4,520	10	-	-	-	6,270
Manitoulin	240	-	-	50	10	-	-	300
Nipissing	1,760	2,540	2,800	200	90	90	-	7,480
Rainy River	110	680	30	120	60	50	-	1,050
Sudbury	100	140	690	1,300	500	540	-	3,270
Thunder Bay	80	-	630	1,040	410	440	-	2,600
Timiskaming	10	7,290	2,570	70	50	30	-	10,020
Northern Ontario	**2,340**	**12,770**	**13,600**	**3,260**	**1,390**	**1,320**	**-**	**34,680**
PROVINCE	**1,538,840**	**599,600**	**2,954,940**	**626,070**	**349,590**	**799,460**	**329,470**	**7,197,970**

[a] Includes fungicides used on fruit and vegetable crops only.

APPENDIX XVII - Quantities of Active Ingredients of Each Type of Pesticide Used on Field Crops, Fruits and Vegetables in the Various Ontario Drainage Basins of the Great Lakes, 1988

Drainage Basins	Herbicides			Fungicides[a]	Insecticides	Nematocides	Growth Regulators	Total
	Triazine	Phenoxy	Other					
LAKE HURON AND GEORGIAN BAY								
Ausable,Bayfield,Maitland	194,660	65,120	353,600	4,230	27,200	390	10	645,210
Saugeen	47,240	21,670	42,170	120	3,070	10	-	114,280
Nottawasaga to Owen Sound	44,370	25,690	27,530	78,990	35,880	11,430	660	224,550
Holland,Severn	16,010	9,230	15,460	19,840	16,950	940	10	78,440
Lakeside land	57,930	27,220	106,030	13,750	10,210	2,510	20	217,670
Total	**360,210**	**148,930**	**544,790**	**116,930**	**93,310**	**15,280**	**700**	**1,280,150**
LAKE ST. CLAIR								
Thames	277,630	71,440	744,770	46,190	43,160	75,660	83,650	1,342,500
Sydenham	108,860	17,720	229,740	2,850	11,110	10	70	370,360
Lakeside land	19,550	4,220	75,050	1,800	1,890	30	40	102,580
Total	**406,040**	**93,380**	**1,049,560**	**50,840**	**56,160**	**75,700**	**83,760**	**1,815,440**
LAKE ERIE								
Kettle to Haldimand	102,260	28,160	360,840	62,070	46,470	637,080	229,310	1,466,190
Grand	206,420	136,290	264,450	24,480	25,440	62,020	12,460	731,560
Lakeside land	110,920	19,010	336,630	83,520	22,480	2,700	1,550	576,810
Total	**419,600**	**183,460**	**961,920**	**170,070**	**94,390**	**701,800**	**243,320**	**2,774,560**
LAKE ONTARIO								
Oakville to Pickering	32,690	14,910	127,820	21,820	7,790	960	550	206,540
Welland,West Lincoln	20,330	10,300	13,330	104,940	37,660	250	210	187,020
Trent	25,840	21,310	41,050	27,340	9,330	600	550	126,020
Moira to Gananoque	12,300	6,910	7,210	120	60	10	-	26,610
Lakeside land	77,690	32,260	84,570	120,230	45,080	2,510	330	362,670
Total	**168,850**	**85,690**	**273,980**	**274,450**	**99,920**	**4,330**	**1,640**	**908,860**
Total of Above	**1,354,700**	**511,460**	**2,830,250**	**612,290**	**343,780**	**797,110**	**329,420**	**6,779,010**
Remainder of Province	184,140	88,140	124,690	13,780	5,810	2,350	50	418,960
Total Province	**1,538,840**	**599,600**	**2,954,940**	**626,070**	**349,590**	**799,460**	**329,470**	**7,197,970**

[a] Includes fungicides used on fruit and vegetable crops only.

APPENDIX XVIII - List of Common (Chemical) and Trade Names

Common Name	Other Name(s)
2,4-D	Amsol, Esterone, 2,4-D Amine 500
2,4-DB	Embutox E, Combutox, 2,4-D Butyric
Bacillus Thuringiensis	Thuricide, Dipel, Bactospeine
DNOC	Elgetol
EPTC	Eptam, Eradicane
MCPA	Methoxone, MCPA-Amine, MCPA-Sodium Salt
MCPB	Tropotox
acephate	Orthene
alachlor	Lasso, Lasso II
aldicarb	Temik
amino triazole + ammonium thiocyanate	Amitrole, Amitrol-T, Cytrol
anilazine	Dyrene
atrazine	AAtrex, AAtrex-Nine-O, AAtrex-Plus, Primatol, Vectal
azinphos-methyl	Guthion, APM
benomyl	Benlate
bentazon	Basagran
bromoxynil	Pardner, Torch, Bromox C-100
butylate	Sutan, Sutan Plus
captafol	Difolatan
captan	Orthocide, Captan
carbaryl	Sevin
carbofuran	Furadan
chinomethionat	Morestan
chloramben	Amiben, No-Hoe
chlorbromuron	Maloran
chlorfenvinphos	Birlane, Supona
chlormequat chloride	Cycocel
chloropicrin	Telone C-17, Vorlex Plus CP
chlorothal-dimethyl	Dacthal, DCPA
chlorothalonil	Bravo, Daconil
chloroxuron	Tenoran
chlorpropham	CIPC, Sprout-Nip
chlorpyrifos	Lorsban, Dursban
cyanazine	Bladex
cyhexatin	Plictran
cypermethrin	Cymbush, Ripcord
daminozide	Alar
decyl alcohol	Antak, Chiptac, Contak, Delete, Emtrol, Emtrol-Ten, Fair-Tac, Pfizol, Royaltac
deltamethrin	Decis
demeton	Systox
diazinon	Basudin
dicamba	Banvel, Dycleer
dichlobenil	Casoron
dichlone	Phygon
dichloropropenes + dichloropropanes	Dichloran-Botran, Telone, Diazol II, C-17, Vorlex Plus, Plus CP
diclofop-methyl	Hoe-Grass, Hoelon
dicofol	Kelthane
difenzoquat	Avenge
dimethoate	Cygon, Rogor, System
dinocap	Karathane
dinoseb	Amine Dinitro, Dinitro, Diazinon,Premerge, Sinox,Topper, Dytop
diphenamid	Enide
diquat	Reglone, Reglone A
diuron	Karmex
dodine	Cyprex, Equal
endosulfan	Thiodan
ethalfluralin	Edge
ethephon	Ethrel, Cerone
ethion	Ethion, Nialate
fenoxaprop-ethyl	Excel
fensulfothion	Dasinit
fenvalerate	Belmark
ferbam	Formate, Ferbam
fixed copper	Basi-Cop, Spray-Cop, Tri-Cop, Kocide
fluazifop-butyl	Fusilade
folpet	Phaltan
fosofos	Dyfonate formetanate
hydrochloride	Carzol
glyphosate	Roundup
ioxynil	Totril
iprodione	Rovral
linuron	Lorox, Afolan F
malathion	Cythion, Malathion
maleic hydrazide	MH 30
manconeb	Dithane M45, Manzate 200
maneb	Dithane M22, Manzate D, Mantox
mecoprop	MCPP, Mecoturf, Compitox
metam-sodium	Vapam, VPM
methamidophos	Monitor, Tamoron
methidathion	Supracide, Ultracide
methomyl	Lannate
methoxychlor	Marlate
methylisothiocyanate	Vorlex Plus and Plus CP
metiram	Polyram
metobromuron	Patoran
metolachlor	Dual
metribuzin	Sencor, Lexone
mevinphos	Phosdrin
monolinuron	Afesin
naled	Dibrom
napropamide	Devrinol
naptalam	Alanap
oxamyl	Vydate
oxydemeton-methyl	Meta-Systox-R
oxyfluorofen	Goal
paraquat	Gramoxone
parathion	Parathion
pebulate	Tillam
permethrin	Ambush, Pounce, Ectiban
phorate	Thimet
phosalone	Zolone
phosmet	Imidan
pirimicarb	Pirimor
prometryne	Gesagard
propargite	Omite
sethoxydim	Poast
simazine	Princep, Princep-Nine-T, Simmaprim, Simadex
streptomycin sulfate	Agristrep, Agri-Mycin-17
sulphur	Sulphur
terbacil	Sinbar
terbufos	Counter
thiophanate-methyl	Easout
thiram	Arasan
triadimefon	Bayleton
triallate	Avadex
trichlorfon	Dylox
trifluralin	Treflan, Rival, Triflurex
triforine	Funginex
zineb	Thiogreen, Dithane Z-78

Mixtures:

2,4-D + mecoprop + dicamba	Killex, Kil-Mor
DCP + MIS	Vorlex
DCP + chloropicrin	Telone C-17
DCP + chlorpicrin + MIS	Vorlex CP
MCPA + MCPB	Tropotox Plus
atrazine + simazine	Ekko, Bramox
bentazon + atrazine	Laddok
bromoxynil + MCPA	Bromox, Buctril, Sabre
chloramben + linuron	Amilon
cyanazine + MCPA	Blagal
cyanazine + atrazine	Blazine
dicamba + MCPA	Dyvel
metolachlor + atrazine	Primextra
naptalam + dinoseb	Dyanap
propanil + MCPA	Stampede CM

Notes: DCP - 1,3 dichloropropene + 1,2 dichloropropane
MIS - methylisothiocyanate

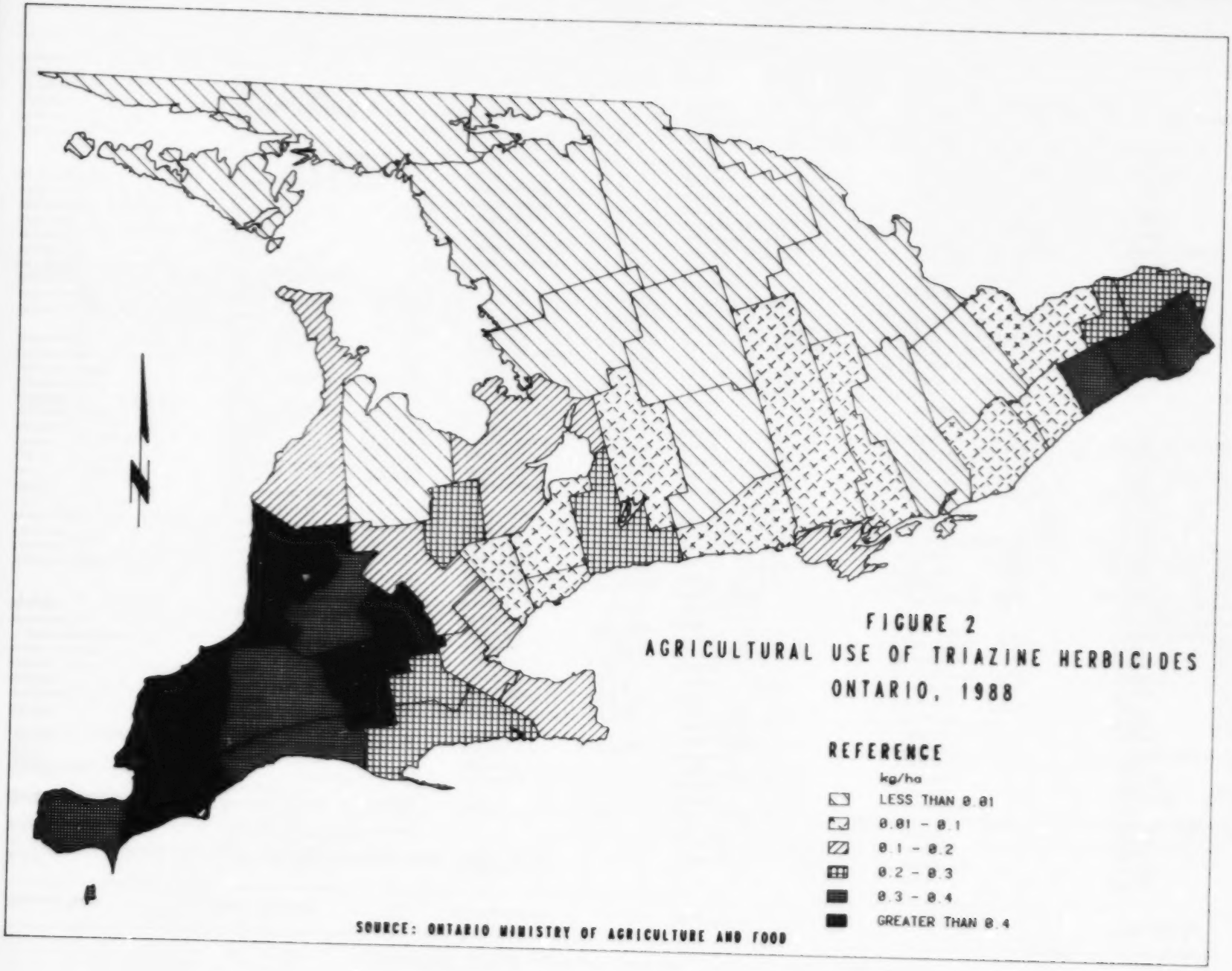


FIGURE 2
AGRICULTURAL USE OF TRIAZINE HERBICIDES
ONTARIO, 1988
REFERENCE
kg/ha
LESS THAN 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
GREATER THAN 0.4
SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD

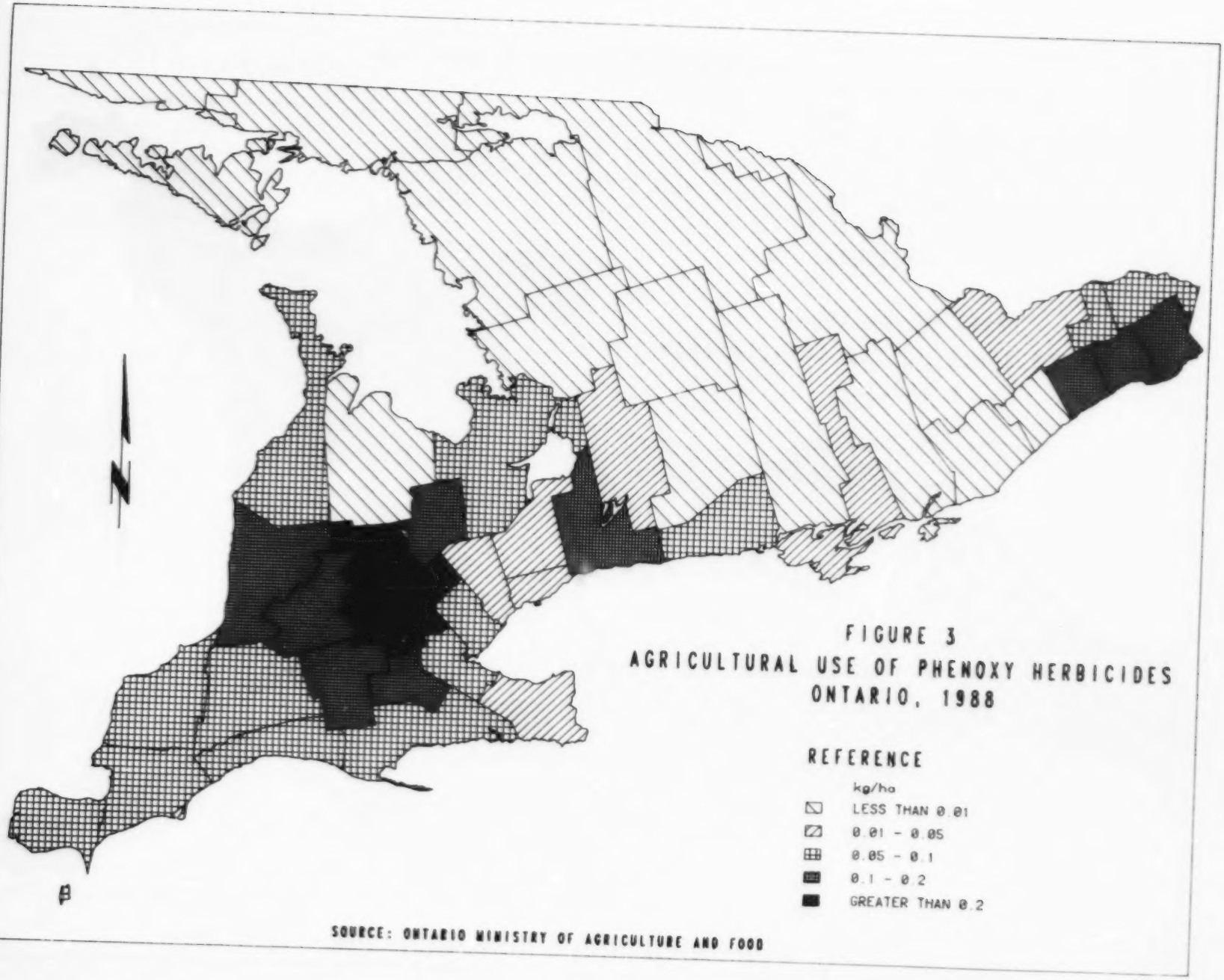


FIGURE 3
AGRICULTURAL USE OF PHENOXY HERBICIDES
ONTARIO, 1988

SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD

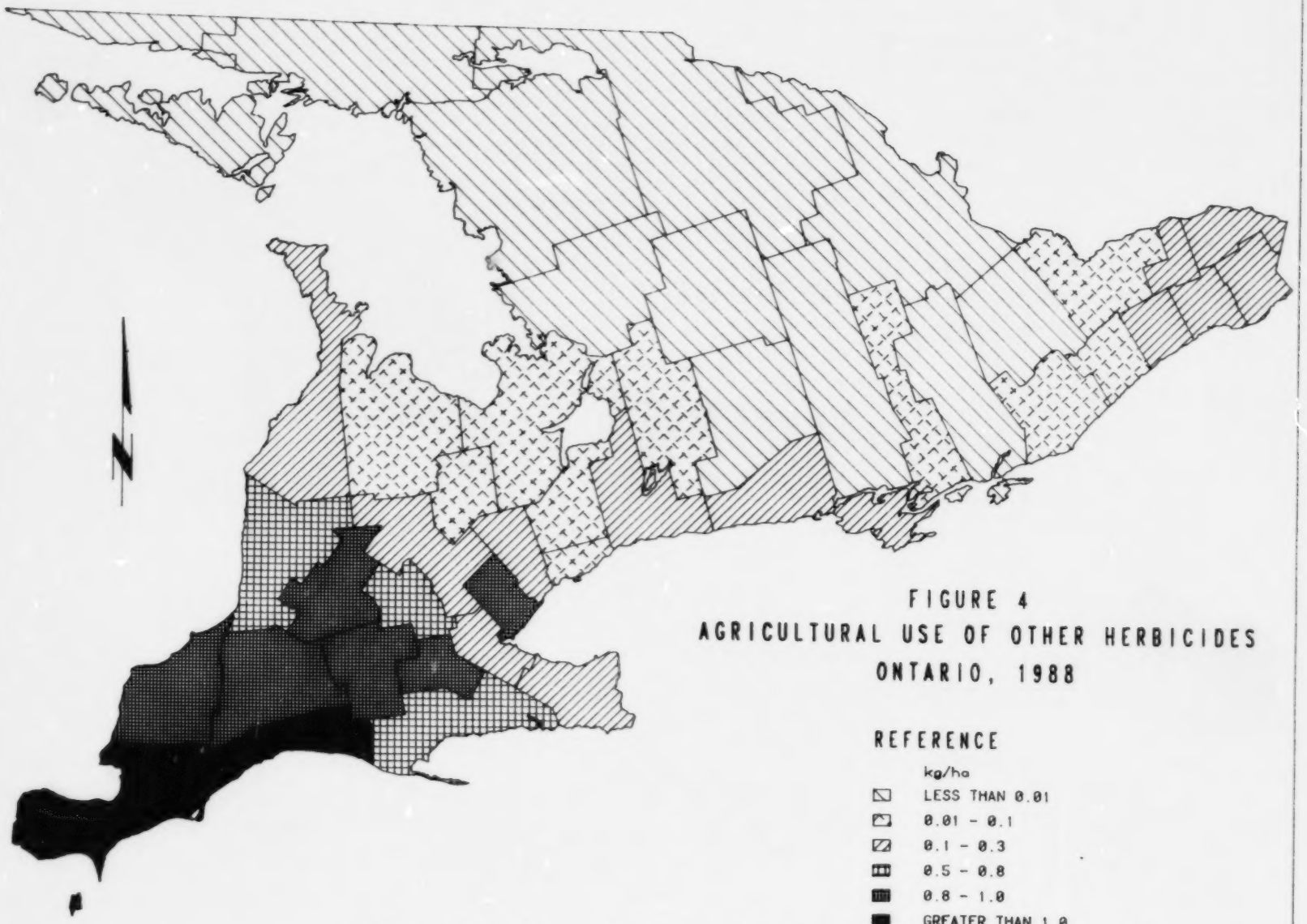


FIGURE 4
AGRICULTURAL USE OF OTHER HERBICIDES
ONTARIO, 1988

SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD

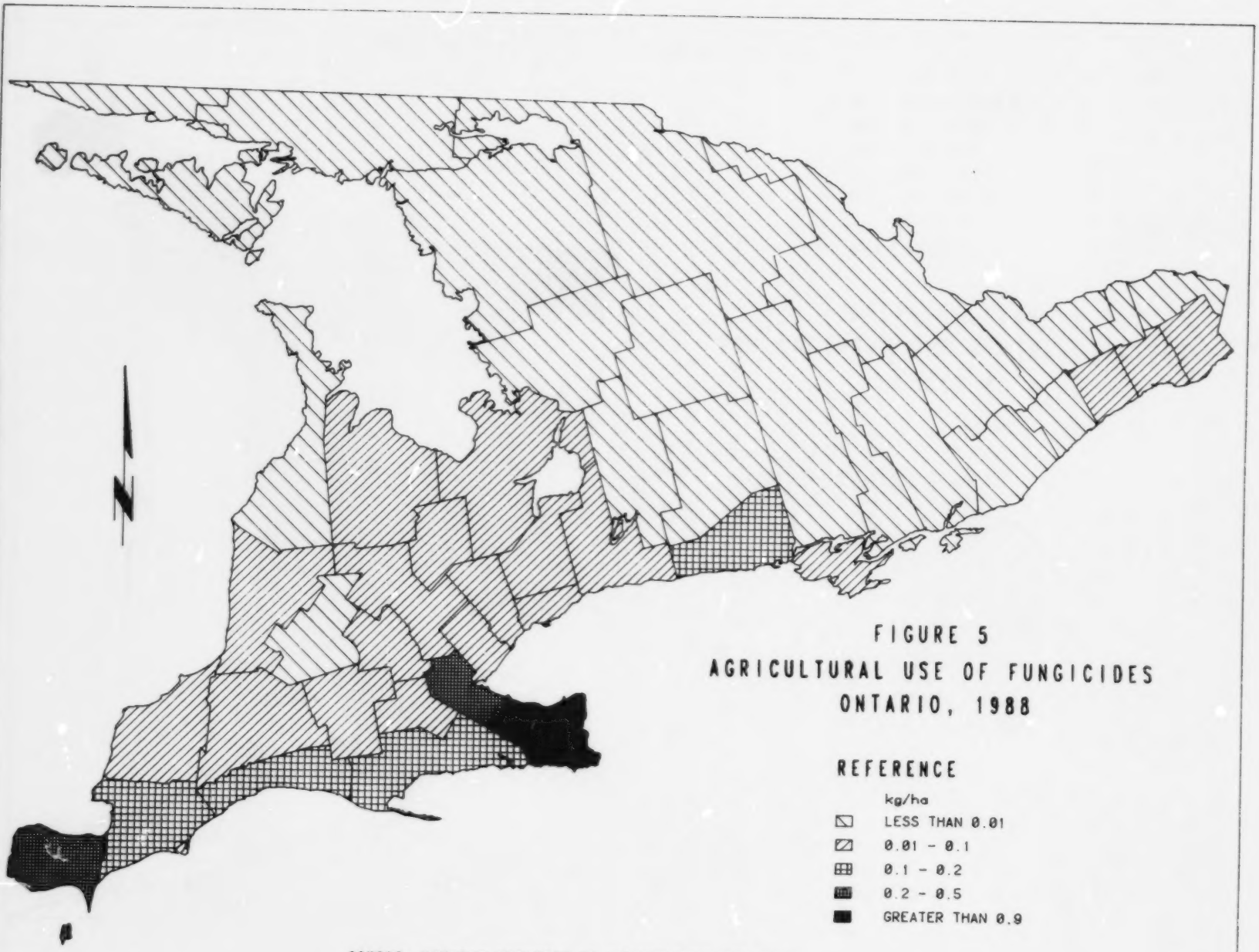


FIGURE 5
AGRICULTURAL USE OF FUNGICIDES
ONTARIO, 1988
REFERENCE
kg/ha
LESS THAN 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.5
GREATER THAN 0.9
SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD

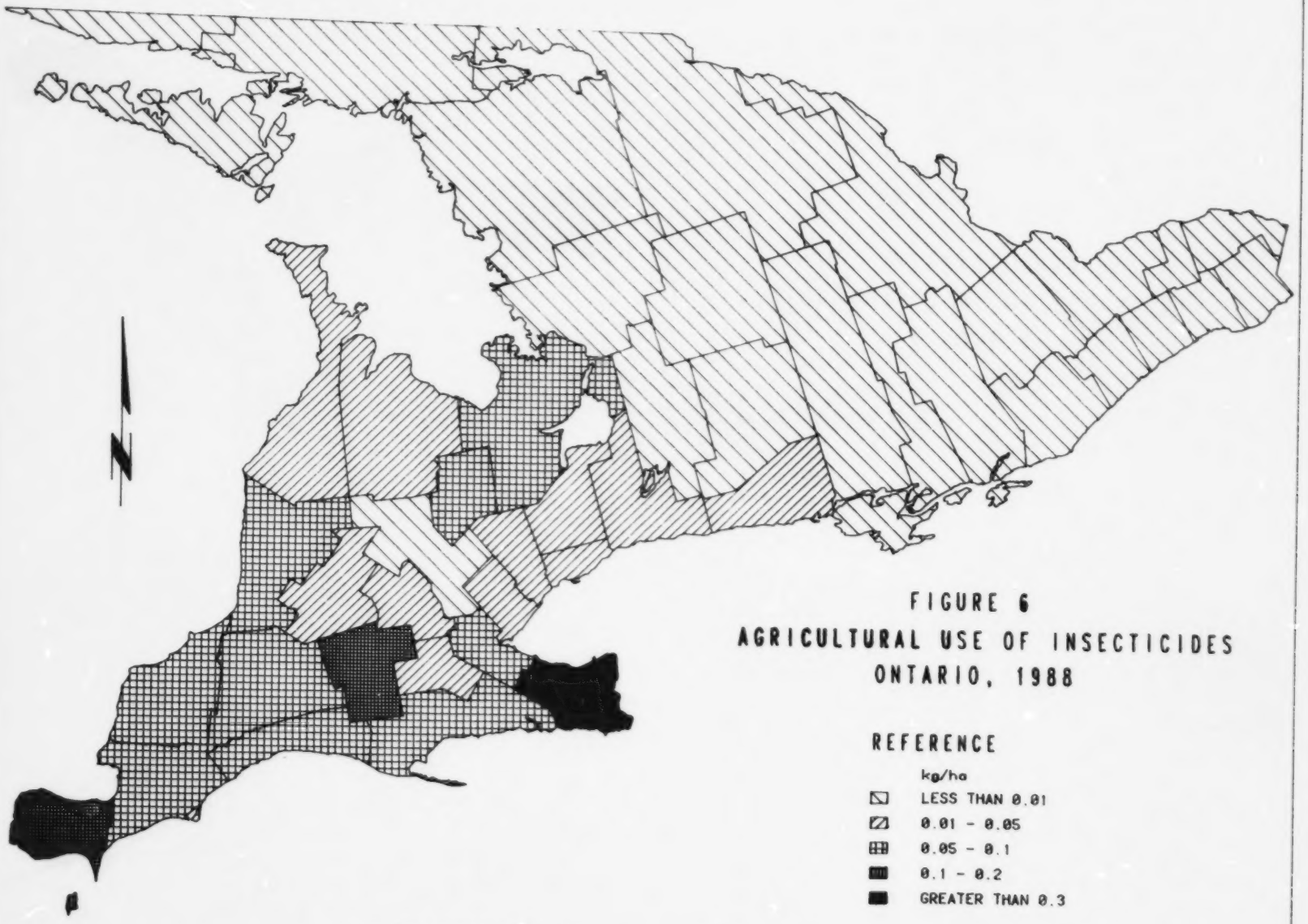


FIGURE 6
AGRICULTURAL USE OF INSECTICIDES
ONTARIO, 1988
REFERENCE
kg/ha
LESS THAN 0.01
0.01 - 0.05
0.05 - 0.1
0.1 - 0.2
GREATER THAN 0.3
SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD

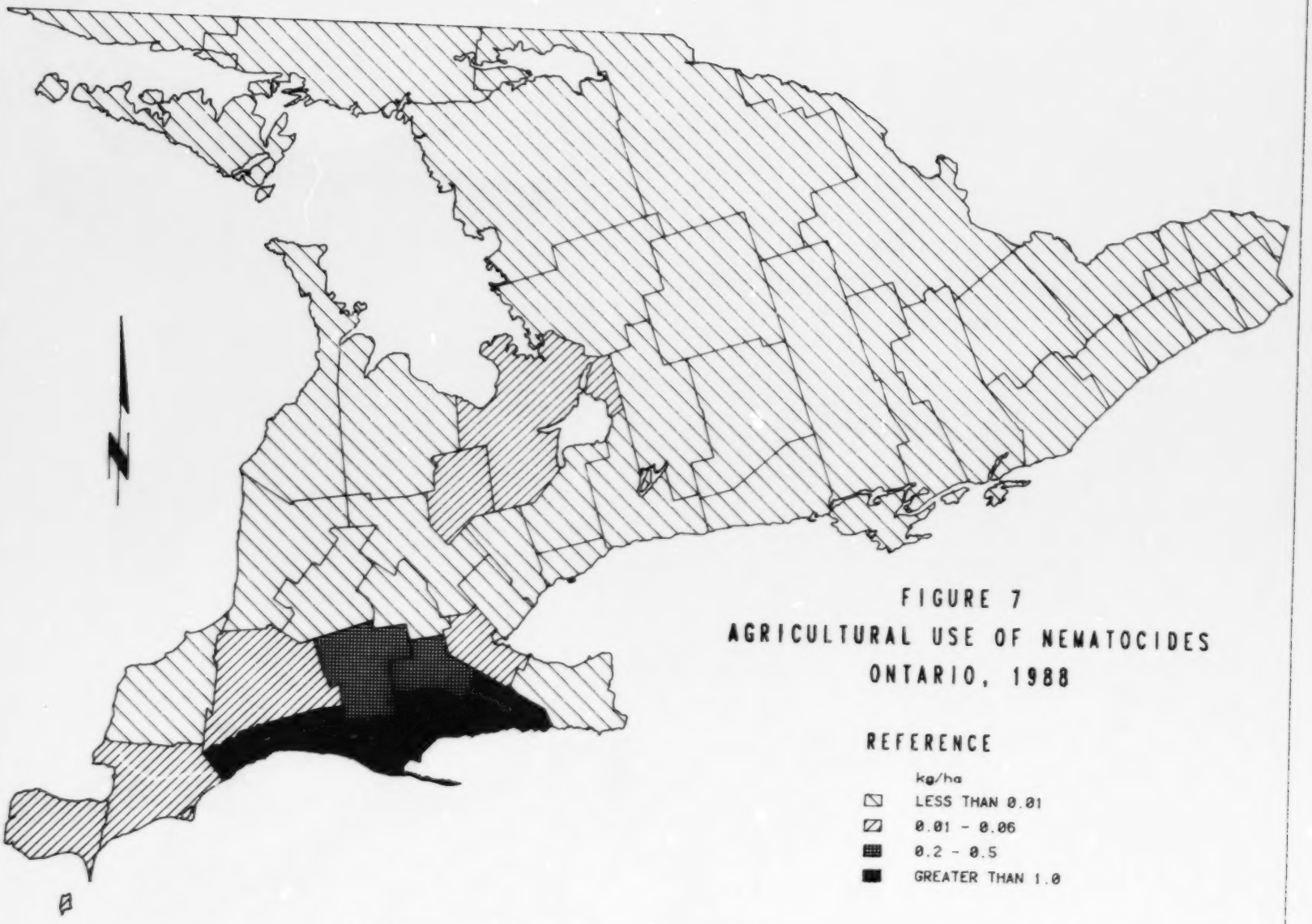


FIGURE 7
AGRICULTURAL USE OF NEMATOCIDES
ONTARIO, 1988

SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD

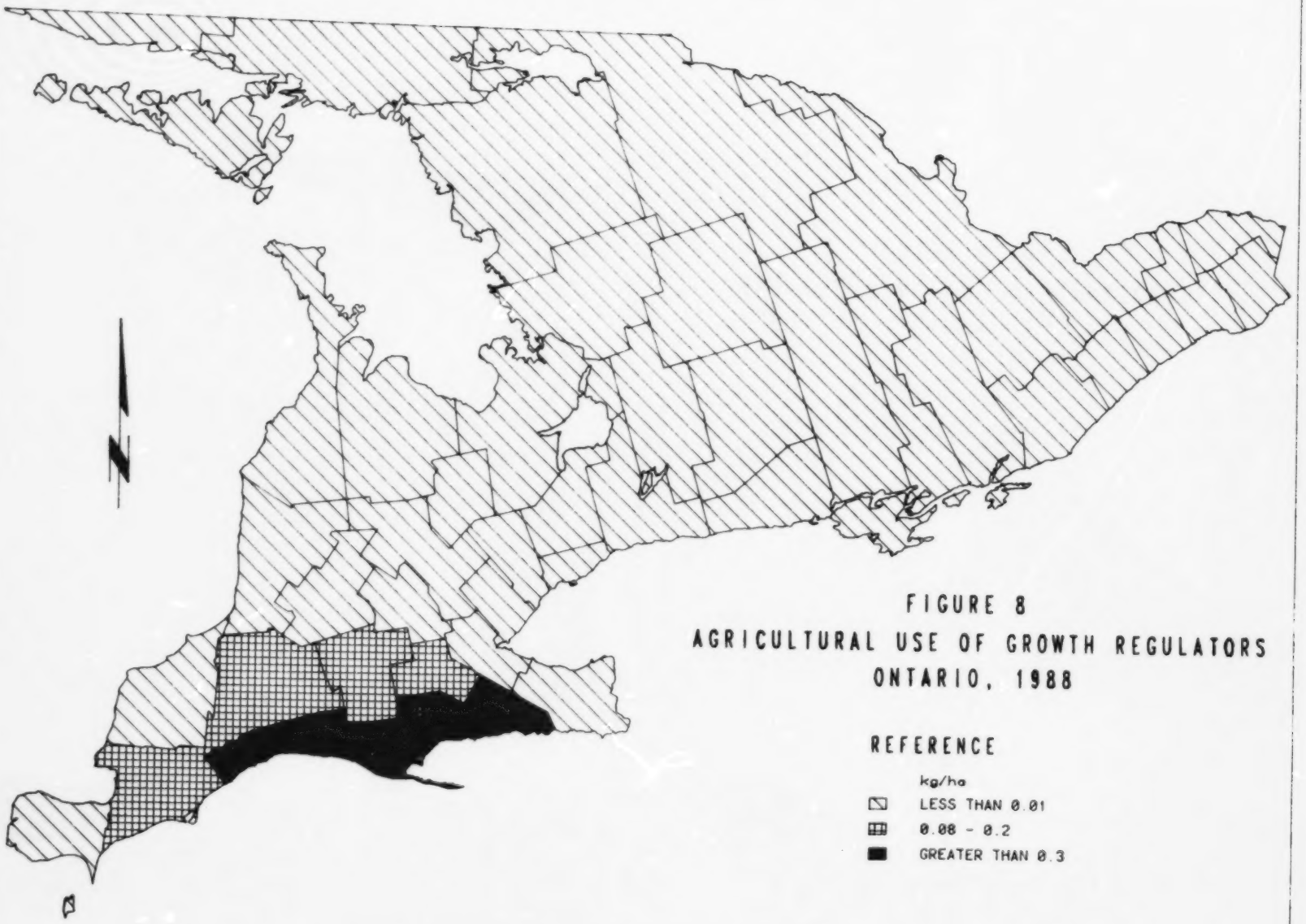
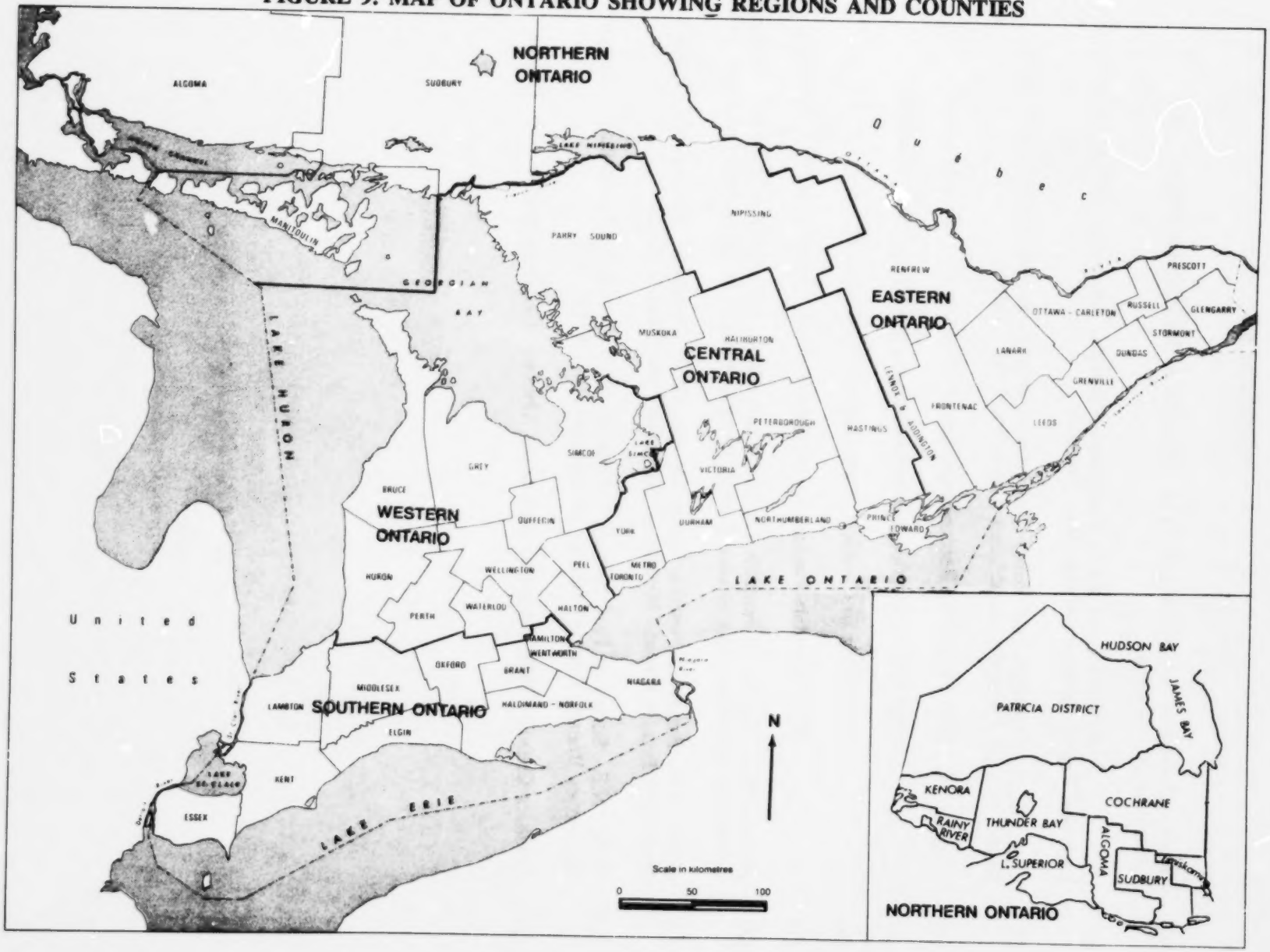


FIGURE 8
AGRICULTURAL USE OF GROWTH REGULATORS
ONTARIO, 1988

SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD

FIGURE 9: MAP OF ONTARIO SHOWING REGIONS AND COUNTIES



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